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The Gag Removed. WE are pleased to see that the bill repealing the secrecy clause of the electrical execution act has passed the Senate, and that hereafter the press will be properly represented. Such a final decision seems in proper keeping with the spirit of the Constitution and the general feeling of Americans in favor of the greatest possible freedom of the press. We rejoice in it from an editorial standpoint, and speaking electrically, it is a subject for congratulation, for not only may a considerable amount of important information be obtained, but there is a decided probability that when the ubiquitous reporter is not excluded, and is furnished with the facts, the reports of executions will possess less of an imaginative character, and we shall hear more common sense and less of the "seething, deadly, current."

Power Transmission by Alternating Currents. THE brief paper by William Stanley, Jr., which we publish elsewhere, gives an interesting view of the alternating current phase of power transmission. It is specially important as bringing to public notice again the very ingenious motor devised by Messrs. Stanley and Kelly, to which reference has several times been made in our columns. One very pretty feature of this machine is the ingenious method for neutralizing lag between field and armature circuits. This question of a practical alternating motor for general use is one of the greatest importance since on the existence of each machine depends the availability of the alternating current in the general transmission of power. In cases where the electromotive force of transmission must be higher than that of utilization, the high efficiency of the alternate current transformer is of no avail unless convenient and efficient motors can be employed in connection with it.

The Trolley Goes. A STRIKING example of the efficiency of the trolley may be seen by New Yorkers who live in Orange. Talking about the mule and horse going, the trolley can beat them at their own game, for it certainly goes at least 50 per cent. faster—retiring the animals at the same time. On the new electric line just opened between Newark and Orange the time between the terminals of the line has been reduced from an hour and seven minutes to 42 minutes. And yet some people persist in wondering why the trolley system is a favorite and why the receipts of a road increase as soon as the horse is discarded and the electric motor put in its place. Just consider the number of friends the new electric line will make and the number of extra 25-minute naps that will be taken in the morning. The wonder is, not that electricity is so frequently introduced, but that horse cars should be tolerated at all when the railway companies can be persuaded into using electricity.

The Sims-Edison Torpedo. THE very successful trial of this American invention, reported in our cable dispatch this week, is both a satisfaction and a disappointment. We are proud of it as an American invention, but we cannot help feeling sorry that the United States government has not laid its hands upon it so effectively as to retain its exclusive use. American inventors of important weapons of war should receive sufficient encouragement on this side of the water to render negotiations abroad both unnecessary and impossible. It is not an agreeable thing to see a foreign power—even so friendly a one as Great Britain—possessed of arms like the Zalinski dynamite gun, the Hotchkiss gun, the Maxim gun, and the Sims-Edison torpedo. Probably these weapons may never be turned against the countrymen of their inventors, but military foresight ought to preclude even the possibility of such an occurrence. We are a peaceful nation, but the events of the last few weeks have shown the desirability of having our weapons handy, and in case of a fracas in Chili it would not have been pleasant to encounter by land the invention of that prince of Connecticut Yankees—Hiram Maxim—and by sea the Sims-Edison torpedo.

Rapid Transit Pays. OUR cable dispatch this week contains a most favorable report on the City & South London Railway. Since that road went into operation it has effectually demonstrated that it has been worked, on the whole, successfully, but there have been, nevertheless, misanthropic individuals who have insinuated that it must prove a commercial failure of such colossal magnitude as to deter investors from trying a like venture elsewhere. The report does not look as if this view of the case were the truth, for a road capitalized as is generally the case, can consider itself on the high road to prosperity when it can pay the interest on its bonds and 5 per cent. on its preferred stock. Receipts have been increasing without any increase of operating expenses, and this year is likely to see even better results than have yet been obtained. Under these circumstances our English friends ought to feel encouraged in going to work on other proposed roads of similar kind at once and pushing them to immediate completion. The dilatory gentlemen who are attending to rapid transit in this city might take so broad a hint and calm their fear that an underground system will not pay, and that really the only thing to do is to give over the upper air to the elevated roads.

Non-Inductive Resistances. A BRIEF paper by Prof. Ayrton, recently read before the Physical Society of London, gives some points on the construction of non-inductive resistance coils. Of course, on a small scale these are perfectly familiar, inasmuch as practically every resistance box is wound non-inductively, but cases frequently arise where resistances must be constructed not for experiments on the laboratory scale, but for that larger commercial work which is so important in modern electrical science; in other words, resistances must be made to carry dynamo currents easily and without serious heating. It is this class of apparatus to which Prof. Ayrton's paper applies, and he has shown how to make resistance boxes constructed of open spirals arranged in non-inductive relation, so as not only to permit of use even in the vicinity of measuring apparatus but for both direct and alternating currents. The self-induction of the spirals usually forming a resistance box is so great as to be very objectionable in alternating current work but the research before us gives several ways out of this difficulty, obtaining at once freedom from self-induction and from magnetic action in the neighborhood. Experimental methods are multiplying in these days, and such neat suggestions as these are always welcome to the electrician whose work necessitates neat laboratory methods.

Mr. Tesla and the Drehstrom Sytems. IN another column will be found a few remarks of Mr. Carl Hering concerning Mr. Tesla's position with reference to the invention of the rotary field motor, written a month ago, but unpublished until now, for the reasons that are made evident to the reader here. It is in final response to communications sent by Mr. C. E. L. Brown to this and other journals ostentatiously upholding Mr. Tesla's rights in the matter. We desire to state right here that THE ELECTRICAL WORLD has over and over put itself on record as upholding Mr. Tesla's priority in the enunciation of the principles of multiphase motors. We have taken this position in the editorial columns several times already, and have had, at no time, any desire to recede from it. The question between Mr. Brown and Mr. Hering as to Dobrowolsky's work in this direction has been discussed quite long enough, and we here take the opportunity of bringing the matter to a close, as it is neither necessary nor interesting. There exists between the two foreign engineers concerned a keen professional rivalry, and THE ELECTRICAL WORLD does not propose to be used as a cat's paw to pull Mr. Brown's chestnuts out of the fire. Both of these engineers are possessed of undoubted ability, which we have always taken pleasure in recognizing, but we do not think that any question as to the merits of their work should be conducted through an American journal and over the shoulders of Mr. Hering, who is the gentleman apparently attacked.

Harnessing Niagara. ELSEWHERE in our columns will be found a very complete account of the present state of the work on the American side of Niagara. It is really a colossal piece of engineering; and although it has been conducted during the past two or three years so quietly that but few reports of it have been made public, a great deal has been accomplished toward utilizing that gigantic source of energy. We are to-day on the very eve of electrical developments in the line of transmission of power that are destined, perhaps, to change profoundly our industrial methods. Until now the world has been wont to rely upon steam, or directly upon water-power, to drive the machinery of its great manufactories. Since the electric motor has sprung into prominence much has been said regarding its use for bringing to the dwellers of our great cities the energy of distant waterfalls, but until very recently comparatively little has been done, and to-day the list of plants purely for the transmission of power is not very extensive. All this is to be changed radically and permanently. Within a comparatively short distance even of New York City there is water power enough to drive half the engines of the metropolis out of business. Electrical methods are now sufficiently perfected for this transference of energy, and equally is all this true of many another city, especially throughout the great west and particularly in the that splendid part of the country that lies on both sides of the backbone of the continent, a region as yet undeveloped but destined some day to become the centre of great industrial achievements. This is the epoch of the transmission of power, and the work at Niagara is but the first step of a mighty progression.

Electrical Transportation. THE interest taken by railroad men in the use of electricity on long lines is daily increasing. Evidences continually come to our notice that the day is near at hand when the fight for supremacy between steam and electricity will assume proportions that five years ago would hardly have been imagined. A commission of nine railroad experts, representing for the most part important Western systems, have been investigating the subject in a practical way, and, after visiting the works of the great electrical companies, have been so impressed with the ability of the electrical engineer to cope with railway problems that a year or two, possibly a few months, will see the initiation of a change that may be almost infinitely far-reaching. Only about two years ago the subject of electric motors for ordinary railway work was first seriously discussed. The suggestions, however, were received incredulously. The tremendous growth of electric railways since then and the great improvements that have been made in the electric motor have inspired confidence, with the result that the motor is looked on now not as a vague possibility, but as an immediate successor of the steam locomotive, even for heavy long distance work. The beginning will probably be in the suburban service of some large city, the continuation over special high-speed lines connecting important centres, and then the growth will be rapid. Several electric companies are already at work making experimental high power locomotives, and before the end of the current year we are likely to see results that will be immensely encouraging even if there is then no deliberate effort to change the system of motive power on the part of any considerable railroad system.

Latest Foreign Electrical News.

(By Cable from Our Own Correspondent.)

LONDON, Feb. 1, 1892.—Mr. Nikola Tesla's lecture on his high frequency work, which has been long promised, will be given before the Institution of Electrical Engineers on Wednesday next at the rooms of the Royal Institution. It has been anticipated with the greatest interest by every one, as Mr. Tesla's previous work shows the importance of the subject.

Prof. W. E. Ayrton delivered his presidential address before the Institution of Electrical Engineers on last Thursday, his subject being electrotechnics. Prof. Ayrton strongly contrasted the facilities for electrotechnical education offered in England and those to be found in Germany and America, and hoped that the large annual expenditure now authorized by act of Parliament for educational purposes would result in different things for the future.

Another trial of the Sims-Edison automobile torpedo was held on Friday last off the Isle of Wight. The torpedo was operated by Mr. Sims, and very favorable results obtained, a speed of over 26 knots being obtained and the steering qualities of the boat being admirable. This trial was purely unofficial, although plenty of government officials were present, and it may be regarded as a preliminary of the official trial before the Admiralty next week.

The directors of the City & South London Railway have just declared a five per cent. dividend on the preferred stock of the company, in addition to interest on the bonds. During the second half of 1891 the gross receipts of the road increased three per cent., while the working expenses remained stationary. The number of passengers carried increased 14 per cent., and the total number carried since the road was opened has now reached about 5,500,000.

Two more electrical companies have recently declared dividends; the St. James one of 8½ per cent., and the Hastings one of 7½ per cent.

Elements of Practical Electricity.*

BY DR. LOUIS BELL.

In setting up a reflecting galvanometer for use with a Wheatstone bridge or for any other purpose, some care should be exercised. First level your galvanometer very carefully, so that the needle swings quite freely, and the damping vane does not anywhere touch. Set the coils magnetic north and south, as can be done by the help of the compass needle, then set up the scale, leveling it until it is horizontal, about 30 inches from the galvanometer, and adjust it so that the zero point of the scale, the wire in the slot, the lamp flame and the centre of the mirror, all shall lie in the same vertical plane. The scale should be placed in position, and lifted so that the reflection of the mirror will fall fairly upon it, and the wire should then be sharply focused on the scale by means of a movable lens. The needle can be brought into proper position by means of the magnet on top of the galvanometer, in case it does not of itself assume the right position. Both galvanometer and scale should be very steadily supported. Proper support is sometimes hard to obtain, and it is frequently desirable in order to check vibration to put under each of the leveling screws of the galvanometer a little disc of rubber, perhaps one-eighth of an inch thick.

So much for the galvanometer, now for the Wheatstone bridge. Fig. 36 shows the general arrangement of the bridge, consisting of four wires, a, b, c, d. The cross connection is made from the point of junction of a and b to that of c and d. In this is placed the galvanometer and the key, which will presently be described. To the points of junction of a and c and b and d attach the wires leading from the battery. Now it is evident that in order that a current may pass through the galvanometer the two junctions of a b and c d must be at different potentials. If they are not, no current will flow. If, therefore, these four conductors were equal no current could flow, because the fall of potential through a and c, for example, would be precisely the same, and the two ends of the galvanometer wire would not differ in potential, and in any case no current will flow through the galvanometer provided the four resistances are related to each other, so that a is to c as b is to d. The reason for this relation is exceedingly simple. Suppose the battery current flows through the two resistances $a + b$ and $c + d$ in parallel. Now, the current divides between these two branches, according to their resistances. The total fall of potential through each branch being the same, for example two volts, the fall of potential through one half the surface $c + b$ will be one volt, and through half the resistance of $c + d$ will also be one volt. If these points were to be connected by a wire no current would flow. In the same way after a quarter of $a + b$ had been passed the drop of potential would be half a volt, and after one quarter of $c + d$ had been passed also the drop would be half a volt. In other words, if the resistances of the two branches a b and c d are divided in the same ratio, no matter what that ratio is, the fall of potential up to the point of junction in either branch would be the same. Therefore, if the resistances are related so that a is to c as b is to d, and the galvanometer be connected across from the junction of a c to that of b d, no current will flow through it. If this particular ratio of the resistances is disturbed of course the current will flow, its direction depending on the resistances that are increased or diminished. If, for example, you construct the bridge with wire, as shown by the diagram, and put in place of the conductor b, the unknown resistance, you could find its equal very simply by varying resistance d, until a point was reached where no current flows through the galvanometer. b and d would then be equal. By having the known resistance for the arm a of the bridge, and the unknown for the arm b, you could then vary both c and d until the same balance was obtained, so that closing the key in the galvanometer would give no deflection. A simple proportion given will then enable you to compute the unknown resistance, knowing the ratio of c and d.

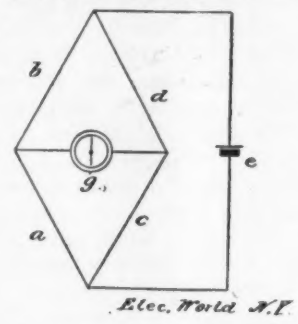

FIG. 36.—DIAGRAM OF WHEATSTONE BRIDGE.

This latter method is one generally employed in using the bridge, on account of its convenience, for you do not need under these circumstances to have variable resistances to insert in a.

Nor do you need to have the absolute value in ohms of the resistances c and d, provided you know their ratio.

It is usual in making a Wheatstone bridge for actual use to make the resistances c and d out of a single uniform piece of wire. The resistance of this is directly in proportion to its length, so that by making contact with the galvanometer wire at various points, and finding one at which there will be no galvanometer deflection, you will divide the wire into two sections whose lengths are directly as their resistances. The ratio of these lengths is then the same as that of the resistances.

You will do well to set to work and construct a bridge on this principle, and you will find it immensely convenient. It is very simple and quite accurate. Take a piece of inch board, 8 inches wide and 42 inches long; procure some very heavy sheet copper, perhaps $\frac{1}{16}$ of an inch thick, cut a strip about 18 inches long and an inch wide, as shown in the figure, cut two other pieces forming right angles, as shown in the same figure, also procure a wooden metre stick, and eight small binding screws. Having carefully shellaced your board, screw the metre stick down with brass screws parallel to and about two inches distant from it, screw down the two angle pieces of copper flush with the edge of the metre stick, and bring their ends nearly level with the top of the metre stick. This may be done by screwing them down upon blocks. Brass screws should be used in all the work, because your bridge is likely to be used in the vicinity of the galvanometer. Screw the piece of copper down upon the board midway between the ends of the angle pieces, which latter may be about three inches on a side. File the screws off seven of your binding posts, and solder them one to the edge of the long strip, one at its middle, one at the angle of each angle piece

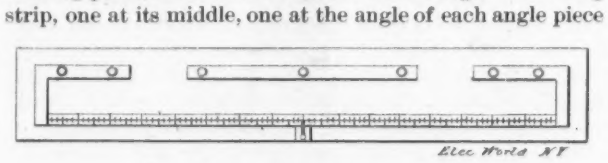

FIG. 37.—SLIDE-METRE BRIDGE.

and one at its end nearest the long strip. Fig. 37 shows the arrangement very nicely. Now take a piece of No. 20 German silver wire about the length of your board. Be careful to see that there are no flaws or inequalities in it. Then stretch it along your metre stick parallel to its edge, solder one end very thoroughly to one of your copper angle pieces, then stretch the wire taut close along the surface of the metre stick and solder the other end thoroughly to the other copper angle piece, so that the wire shall lie tight along the metre stick through its entire length. Continue the solder clear up to the edge of the copper angle pieces. Now prepare a contact key. It is very simple, consisting of a square block about two inches on an edge and a quarter of an inch thick, with a spring of spring brass half an inch wide and nearly three inches long screwed down upon it, as shown in the cut. To the base of this spring a binding post should be screwed.

Now take a small piece of sheet brass, perhaps one-sixteenth of an inch thick, and solder it to the end of the spring, the edge projecting downward. File off the brass to a blunt edge, and trim off the point, so as to form a pointer, which will come down close to your metre stick. Now by pressing this contact key against the edge of the metre stick you can slide the key along, and at any time by pressing lightly down on the spring you can make contact with the German silver wire. At the same time bring the end of the pointer down close to the scale on the metre stick, so that you can see its exact position. The metre stick should be divided to millimetres. When your Wheatstone bridge is complete, one of the wires from the galvanometer should be connected to the centre binding post of the long copper strip, the other to the key. The resistance corresponding to a in Fig. 36 should be inserted between the two binding posts at the ends of the long strip and at the adjacent end of an angle piece respectively. The wires from the battery go to the binding posts at the corners of the angle pieces. The unknown resistance which you wish to compute should be put in the remaining gap, between the long strip and the angle piece, and connected to the binding screws.

Referring to Fig. 36 a is the known resistance, b the unknown and c and d are the two parts into which the German silver wire is divided when you press down the key. The current from the battery divides, part of it passing through the bridge wire and the other through the resistances, and when these two sides of the circuit are divided in equal ratio as regards resistance no current will flow through the galvanometer.

You can now go on to the actual measurement of resistances. You have, for example, a two-ohm coil. Ten or fifteen feet of your finest copper wire is the unknown resistance. Then having set up your galvanometer put the key in place near the middle of the wire and make contact. If the spot of light on the scale flies to one side, note in what direction it moves, and then shift the position of your key. If on making contact the spot moves faster, move the key in the other direction next time; if slower move the key a little further in the same direction. If you find on shifting the key that the spot of light moves in the direction opposite to that it took when you last pressed the key, the position of balance is between the last two positions of the key. A little practice will enable you to readily find the point at which there is no movement of the spot of light. Your German silver wire is then divided according to the ratio that we previously mentioned, and you can, simply by knowing the relations of these two parts, compute the unknown resistance which you wish to find. One little trick is well worth mentioning here. In beginning work bring down the controlling magnet of the galvanometer near to the needle, so that the instrument will not be too sensitive. As you get more accustomed to its use you can employ it with greater and greater sensitiveness. The spot of light moves quite rapidly, and may take some little time to come to rest. It is not agreeable to wait for it, and by a simple device you can check it almost instantly. Press down your contact key and the spot moves, as it passes the centre of the scale on its backward swing touch the key lightly. This gives an impulse as before, and with exactly the same force, and this is just enough to stop the needle. A few trials will enable you to bring the spot of light to rest in a very few seconds.

After getting a little used to the instrument you will be able to determine the ratio between the two ohm coils which you have constructed. This you can do very accurately by inserting one of them as the known and the other as the unknown resistance, and balancing them with the contact key.

You had better practice on the bridge until you get pretty familiar with its use, and can make the balances and compute the resistances rapidly.

In the next section of this article will be mentioned some further points regarding the use of the bridge, and some other methods of resistance measurement. We will then take up various electrical measurements.

Mr. Tesla and the Drehstrom System.

BY CARL HERING.

As Mr. C. E. L. Brown, in communications to THE ELECTRICAL WORLD and other journals, seems determined to insist that I have neglected the work of Mr. Tesla on rotary current, I wish here to state that there is no one more ready than myself to give Mr. Tesla due credit for his work, and I have always considered him to be an original inventor of the rotary field system and the first to reduce it to practice, and I believe I so stated it in my articles. If I have at any time failed to give him credit for the extent to which he developed it, it has been because Mr. Tesla has been too modest (or perhaps prudent) to let the world know what he had accomplished, and we ought therefore not to be blamed if we do not always know what he has done. When the articles which have caused this discussion were being written, Mr. Tesla's patents were not accessible to me. Just where Mr. Dobrowolsky's improvements begin I have not yet been able to ascertain.

The fact that I have personally tried to persuade Mr. Tesla to write a paper on his work in this field will show that I am very anxious myself to know just how far he carried his work, and why it was not continued. In justice to Mr. Dobrowolsky, it ought to be said that if Tesla did not publish his researches other than his patents, Dobrowolsky ought to have the credit at least for what he did that was not included in Tesla's patents. Dobrowolsky, though he may have been an independent inventor, admits that Tesla's work is prior to his, but he claims to have made

*Continued from THE ELECTRICAL WORLD of Jan. 30, 1892.

improvements. In my articles I distinctly stated that I did not wish to enter into a discussion of the subject of priority. Dobrowolsky's system has proved itself to be a success; it was natural to assume that he had made some improvements. It must be left to a discussion between Tesla and Dobrowolsky, and not to others, to determine, if necessary, just where the one left off and the other began. The modesty of both of these gentlemen would, I feel sure, lead to a clear understanding.

Niagara Falls Power Plant.

The construction of the power plant for utilizing and distributing a portion of the power of Niagara Falls is now well under way, and a short description of it, as far as it could be obtained at present, will doubtless be of interest to many electricians. The present work is limited to the construction of the long tunnel, no definite plans having yet been decided upon for the electrical equipment. Owing to the enormous proportions of the plant some of its general features will doubtless be of interest at the present time.

The general plan for the power station is to construct a large turbine plant on the American side of the Niagara River, about a mile above the falls, and to erect in the immediate vicinity a large number of mills for various purposes. The water will enter a series of vertical shafts with turbines at the lower end, which discharge their water into a long tunnel leading out into a point below the falls. This tunnel, therefore, forms merely a tail race to carry off the water of the turbines. The great advantages of such a plant need hardly be mentioned here; it is expected that a large manufacturing city will be developed at this place, which some persons believe will, before long, have a million inhabitants. The shipping facilities include waterways to the West and railroads in all directions. The plant includes railroad lines running directly from the mills to all the principal trunk lines. The size of the plant will best be appreciated from the fact that the tunnel is built for a capacity of 100,000 h. p. net, from which a good idea can be obtained of the size of a manufacturing city which would utilize this power. In order to get the advantages of the best possible talent on this subject an advisory international committee was appointed, consisting of the following well known authorities: Sir Wm. Thomson and Prof. Unwin, of England; Prof. Mascart, of Paris; Col. Turitini, of Switzerland, and Mr. Coleman Sellers, of Philadelphia.

The total power of the falls is estimated variously at from 3 to 16 million h. p., from which it would be seen that the largest amount of power which this plant will consume is only from 1 to 3 per cent. of the total power of the falls, and it is therefore not likely that its effect will be noticed. The complaints that this plant will affect the beauty of the falls need therefore not be considered.

The general plan of the plant will be seen from Figs. 1 and 5. Fig. 1 is a map of that portion of the country, showing the large area which is to be occupied by the mills, also the canal which forms the upper water race, and the tunnel which is the tail race, and which leads the water from the turbines to the nearest point below the falls. Fig. 5 is a plan of the power plant itself, showing the canal, the location of the turbines, and the tunnel by which these turbines are connected to the main tunnel. The general plan is to utilize the power in three different ways, as follows: First, for the mills in the immediate vicinity of the upper end of the tunnel. Each mill will have its own vertical shaft and turbine and will be connected by a branch tunnel at the lower end with the main discharge tunnel. The area thus supplied will be limited to the distance to which it will be practicable to construct such connecting branch tunnels. Secondly, there will be a number of turbines used to compress air, which will be transmitted by means of pipes to the more distant places, where it will be used to drive air engines. It will also be used to a large extent for refrigerating purposes. Thirdly, there will be a large electrical plant from which current will be distributed for lighting, heating and power purposes, including the railways through and in the vicinity of the city. From this portion of the plant power will also be transmitted to the neighboring cities, including a large amount for the city of Buffalo.

The tunnel and its construction is shown in Figs. 2, 3 and 4. Fig. 2 shows a section, Fig. 3 a profile of the work, and Fig. 4 a view of the lower end, showing the method of constructing it and the point where the connection was broken through on Christmas night between the two lower portions of the tunnel. It will be seen from Fig. 3 that the tunnel is started in three different places, at the outlet and from two vertical shafts. The tunnel is 6,700 feet long, or about one mile and one quarter, it is 18 feet 10 inches wide and 21 feet high, and is lined throughout with brick. Its size may be appreciated from the fact that a double line of railroad trains could pass through it. It was started on October, 1890, and is to be finished in July of this year. The cost of it is $900,000. The lower portion is quite dry, but in the two shafts much water was encountered, making the construction quite difficult. The shafts are 260 and 196 feet in depth respectively. The grade is to be $\frac{7}{16}$ of one per cent. A short article on the construction of this tunnel may be found on page 33 of *Engineering News* of Jan. 9, from which journal some of the

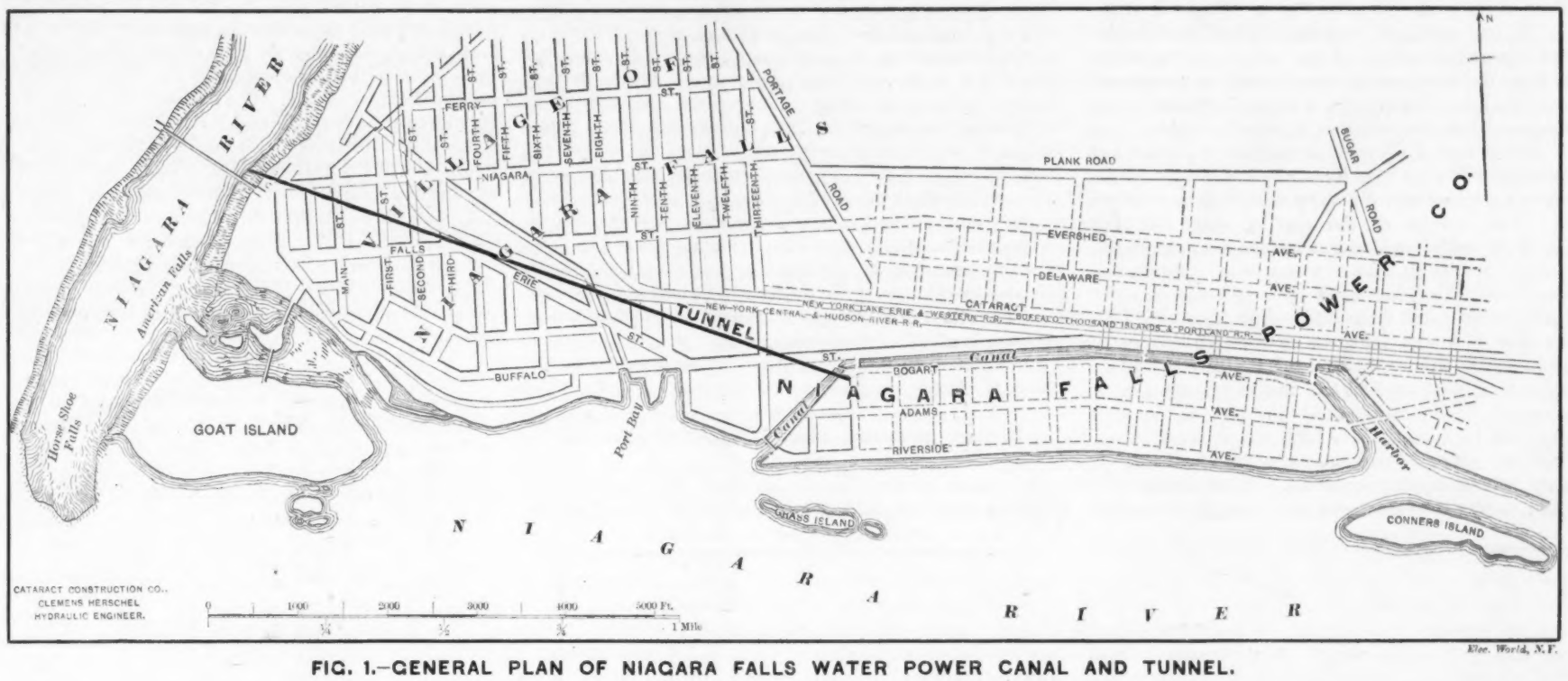

FIG. 1.—GENERAL PLAN OF NIAGARA FALLS WATER POWER CANAL AND TUNNEL.

Regarding the subject of priority, it may be of interest here to say that in a conversation with Prof. Ferraris, last summer, that gentleman told me with very becoming modesty that, although he had experimented with the rotary field several years before Tesla's work was published, he did not think it was possible that Tesla could have known of his work, and he therefore believed that Tesla invented it entirely independently. He also stated that Tesla developed it much farther than he (Ferraris) did.

An Important Legal Decision.

Among the decisions handed down by the Court of Appeals recently is one favorable to the relator in the case of the People *ex rel.* the Brush Electric Illuminating Company, appellant, *vs.* Edward Wemple, Comptroller. The decision, it would seem, disposes of the interesting legal question whether or not a company which generates and distributes electricity is a manufacturing company within the meaning of the statutes of the State, and therefore exempt from the payment of State taxes.

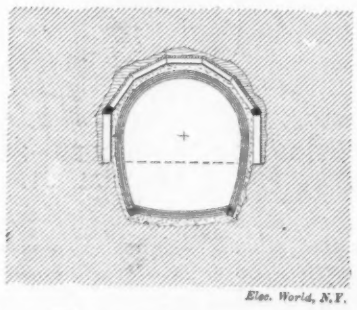

FIG. 2.—CROSS SECTION OF MAIN TUNNEL (21 × 19 FT.).

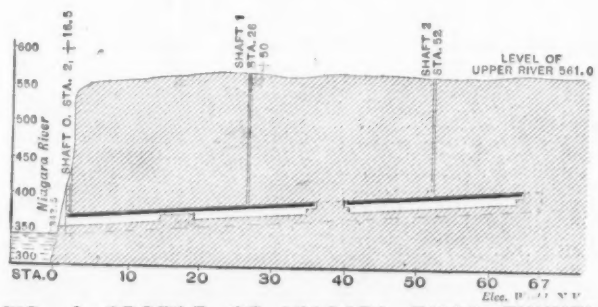

FIG. 3.—PROFILE OF NIAGARA FALLS TUNNEL TO DEC. 24, 1891.

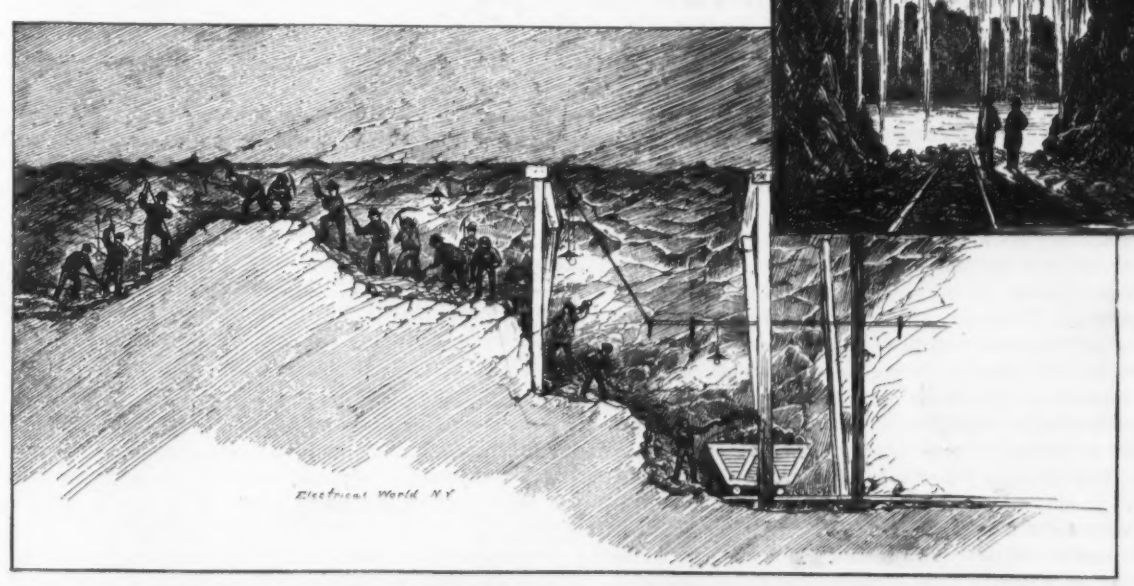

FIG. 4.—LONGITUDINAL AND SECTIONAL VIEWS OF THE NIAGARA TUNNEL.

cuts were taken. The tunnels are lighted electrically, partially by arc lights and the lower end by incandescent lights from a 1,000 volt alternating current system. Much trouble, however, has been experienced with the insulation of the lines. For this reason the drilling has not been done by electrical power, the old method of compressed air being used instead.

The turbines used will be located at the bottom of the shafts, and will transmit their power by a straight vertical shaft to the surface, as shown in Fig. 6. The head of the water is 130 feet net; the turbines will be regulated by hydraulic apparatus located at the bottom of the shafts operated from the surface and using water as a source of power for operating them. An interesting feature about these turbines shown in the figure is, that the water is led up from the bottom of the turbine instead of down from the top as usual; this is a very ingenious and simple device to overcome a very serious difficulty in such high pressure turbines. The weight of the driving shaft and the turbine itself, in addition to the enormous pressure of the water, would be so great that it would be practically impossible to construct a bearing which would run cool and not cut; the turbines and their support are, therefore, proportioned in such a way that the pressure of the water coming from below will just balance this downward thrust; in other words, it is equivalent to a bearing running on a water support. The units of these turbines are fixed at 2,500 h. p., and, perhaps, some of 5,000. For the main plant the turbines will all be located in a long horizontal tunnel, where they will be readily accessible. The dynamos will revolve in a horizontal plane, and will have their vertical

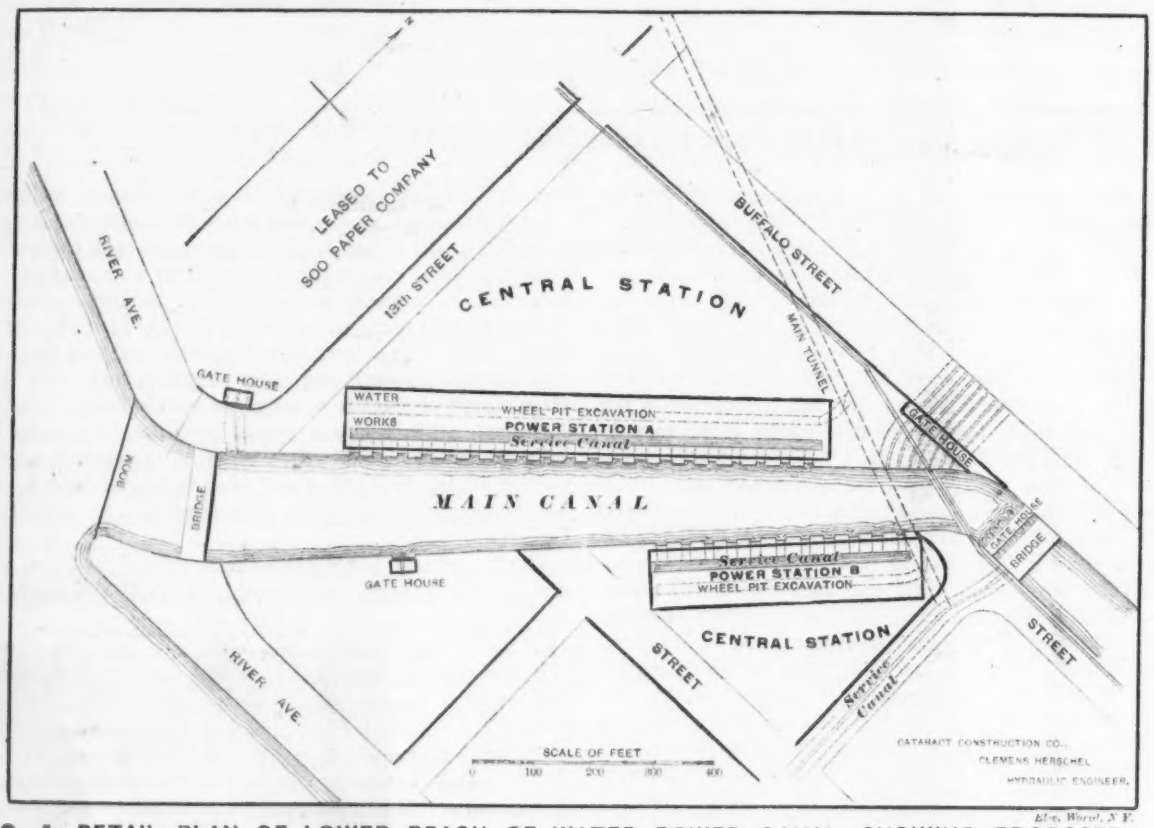

FIG. 5.—DETAIL PLAN OF LOWER REACH OF WATER POWER CANAL, SHOWING PROPOSED POWER STATIONS AND WATER-WORKS.

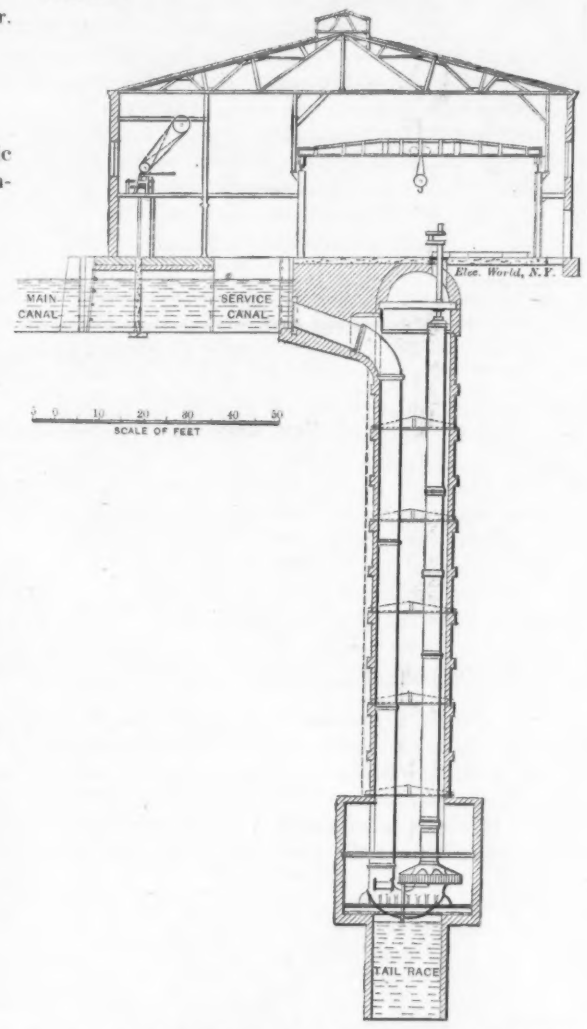

FIG. 6.—SECTION OF PROPOSED HYDRAULIC MACHINERY FOR A CENTRAL STATION.

shafts connected directly with the turbine shafts. The air compressors will consist of two cylinders at right angles to each other, operated from a common crank on the top of the shaft, a system used in the famous Geneva pumping plant in Switzerland.

At present they are arranging for a plant of 15,000 h. p., some of which will be used for air compressors and some for electrical power. These two systems are the only ones under consideration at present, as rope transmission does not seem to be contemplated at all. It may be of interest to state here, that rope transmission, which is used quite extensively in Switzerland, is being replaced there quite rapidly by electrical transmission. Its inefficiency and its liability to stoppages make it rank far below the other systems. It is thought that the power plant will be started this year.

Regarding the electrical systems to be used, very little information can be obtained at present. Many plans have been submitted from the largest companies both here and abroad, but the results are not yet made public. The dynamos will be horizontal, that is, will have a vertical shaft and will be of 2,500 h. p. each, or 1,860 kilowatts. It will be seen from this figure that they are not only larger than any that have yet been constructed, but they are so much so that the largest of the present dynamos are quite small in proportion. Regarding the system of distribution to be used, nothing definite could be ascertained except that for long distance transmission nothing but alternating currents are considered.

The promotors have been watching with great interest the results of the experiments made with the three-phase system this year between Lauffen and Frankfort, which have been fully described in these pages, and they believe, at present, that this is the solution of the problem. It is quite likely, therefore, that the three-phase alternating current will be used, chiefly, of course, because this affords a simple and convenient system for distributing power as distinguished from merely transmitting it. If, as is not at all unlikely, a simple alternating current system is meanwhile developed by means of which motors may be operated as readily and as satisfactorily as with the three-phase system, the latter will doubtless have to give way to it, and it is believed that the anticipation of such a system is one of the reasons why no definite plans have as yet been adopted.

For the distant transmission it is not likely that anything less than 10,000 volts will be used, which for a 2,500 h. p. dynamo means a current of about 186 ampères to be transmitted through the line. The Lauffen plant was considered to be a transmission on a very large scale, but compared with this it is almost insignificantly small, as the current in that case was only about eight ampères. In transmitting the current to a distant city like Buffalo, it is likely that a system of very high tension will be used up to the city limits and there reduced by transformers to, say, 1,000 volts, at which it will then be distributed throughout the city. As the cost of power in this plant includes only the interest on the investment, the depreciation and repairs and the cost of management, it will doubtless be very cheap, and therefore the distribution of the power will be based on different conditions than in most cases at present, in which economy of power is of prime importance.

For much of the data given above we are indebted to Mr. Albert H. Porter, the engineer in charge.

Reports of Boston Electric Light Companies.

The report of the Commissioners of Gas and Electric Lighting of the city of Boston calls attention to the companies which furnish electric light and power in that city. The most prominent is the Boston Electric Light Company, which has a contract with the city. The condition of this company, as shown in the report on June 30, was as follows:

ASSETS.

	1891.	1890.	Inc.
Real estate	$336,786	$324,125	$12,661
Steam plant	228,510	217,903	10,607
Electric plant	299,907	268,553	31,054
Lines, meters, lamps and globes	744,330	648,107	96,223
Due for light and power	29,017	25,578	3,439
Fuel on hand	13,549	12,265	1,284
Materials on hand	21,582	24,116	*2,534
Office furniture	1,661	2,161	*500
Sundry accounts	2,282	4,501	*2,219
Cash	10,120	5,309	4,811
Total	$1,687,744	$1,532,618	$155,126

* LIABILITIES.

	1891.	1890.	Inc.
Capital stock	$1,076,000	$1,000,000	$76,000
Bonds issued	300,000	291,000	9,000
Notes payable	88,078	56,783	31,296
Unpaid bills	28,396	24,135	4,261
Interest due, not paid	6,051	5,894	157
Balance profit and loss	189,218	154,806	34,412
Total	$1,687,744	$1,532,618	$155,126

PROFIT AND LOSS ACCOUNT.

Credit items:	1891.	1890.	Inc.
Balance brought forward	$154,806	$105,821	$48,985
Net earnings	123,797	133,767	*9,970
Rents	3,252	1,459	1,793
Premium on bonds sold	720	.....	720
Jobbing account	3,799	8,217	*4,418
Total	$286,376	$249,265	$37,111
Debit items:			
Dividends declared	$62,280	$60,000	$2,280
Interest paid	22,128	19,759	2,369
Paid leased companies	12,750	14,700	*1,950
Balance carried forward	189,218	154,806	34,412
Total	$286,376	$249,265	$37,111

* Decrease.

Since the above report was prepared the capital has been increased $181,800, making total outstanding Jan. 1, 1892, $1,257,800. The capital authorized by the charter is $3,000,000, but by stockholders' votes so far only $1,500,000 has been authorized. Of this about $700,000 was issued in exchange for appraised real estate, rights, privileges, machinery and plant secured by the several amalgamations of the Brush, American, Merchants' and Citizens' companies and the remainder was issued for cash expended in the plant.

The latest absorption was of the Citizens' company, of East Boston. The company now supplies between 500 and 600 customers including the city of Boston. There is no permanent contract with the city, but by agreement from month to month the service is performed for 40 cents per lamp per night. Stock of the company was recently sold by auction at 104 ex dividend. The stock is principally held in Hartford, Conn. The officers are F. A. Gebbert, Brookline, president; Hugh O'Brien, Boston, vice-president; S. S. Sias, Cambridge, treasurer; D. N. Richards, Isaac Fenno and William Butterfield, Boston; Edward B. Maltby, Taunton; H. S. Hyde, Springfield, and James English, New Haven, directors. The light and power is manufactured under the Thomson-Houston system, but the bulk of the business is supplying arc lights.

The Edison Electric Illuminating Company operates under the Edison system, and reports its condition June 30, as follows:

ASSETS.

	1891.	1890.	Inc.
Balance brought over	.....	$17,901	.....
Real estate, steam plant, electric plant, lines, meters, lamps, globes, patent rights	$1,728,607	1,180,521	$548,086
Due for light and power	41,398	29,638	11,760
Materials on hand	61,021	43,061	17,960
Sundry accounts receivable	2,697	906	1,791
Cash	189,843	9,680	180,163
Notes receivable	41,698	136,032	*94,333
Total	$2,065,268	$1,417,727	

LIABILITIES.

	1891.	1890.	Inc.
Capital stock	$1,263,500	$1,160,000	$103,500
Bonds issued	703,000	150,000	553,000
Notes payable	10,000	35,000	*25,000
Unpaid bills	11,419	47,139	*35,720
Reserved fund	.....	12,000	*12,000
Depreciation fund	39,000	.....	39,000
Bills payable	29,672	13,587	16,085
Balance profit and loss	8,676	.....	.....
Total	2,065,268	1,417,727	

PROFIT AND LOSS ACCOUNT.

Credit items:	1891.	1890.	Inc.
Balance brought forward	.....	$5,913	.....
Bal. el. mfg. acct. (net earnings)	$132,758	82,796	$49,962
Balance carried forward	.....	17,901	.....
Debit items:			
Balance brought forward	17,901	.....	.....
Dividends declared	63,800	12,500	51,300
Interest paid	13,255	12,111	1,144
Construction charged off	2,124	70,000	*67,876
Carried to reserve	.....	12,000	*12,000
Depreciation	27,000	.....	27,000
Balance	8,676	.....	.....

*Decrease.

This company has two plants in operation in Boston, the first at 3 Head place, the other on Hawkins and Bowker streets. A third plant is nearly completed on the water side of Atlantic avenue, between Oliver and Pearl streets, which it is stated will be larger than the other two combined and one of the largest light and power manufacturing houses in the country. Its immediate capacity will be 10,000 h. p., which may be increased to 25,000 h. p.

The company now supplies about 2,600 customers, including about 250 arc lights. It sells more power, it is stated, than any station in the United States. The Edison

General Electric Company (the parent company) owns 3,179 shares of its stock, 69 Massachusetts stockholders own 7,316 shares, and eight people outside the State own 2,140 shares, all of which have been paid for in cash at par. The officers of the company are: Jacob C. Rogers, president; W. C. Balies, vice-president; C. L. Edgar, general manager; W. W. Gooch, clerk; Hubbard Breed, treasurer; W. Powell Mason, T. Jefferson Coolidge, Richard D. Rogers, Geo. S. Silsbee, C. H. Coster and F. S. Hastings, directors, the two last named being also officers of the Edison General Electric Company.

The Distribution of Power by Direct Currents.*

BY ALEX. DOW.

It is part of the programme for this evening that I shall advocate the use of direct currents for long distance power transmission. I have taken this task with pleasure, believing that I have a strong case to present to you, but I beg you will remember that what I may say in favor of direct or against alternating methods is said from the standpoint of the engineer, and that as an engineer I must recognize the necessity to the world of each and every line of development now open to electricity. There is no electrical phenomenon which we can afford to say is trifling and not worthy of careful investigation. But a few years ago the alternate current transformer was merely a scientific toy; to-day it is as practical a piece of engineering as the locomotive. Until now the condenser has had but a limited application in telegraphic work. To-day it promises to become as important to industrial electricity as the transformer. I do not know but that the next few years may see Holtz or Wimshurst static machines built on as large a scale and used as extensively as magneto-electric machines are now.

Therefore, I must consider the power transmission problem as it stands this evening, and leave to those who are prophets and sons of prophets the prediction of what its future will be. And if I, in my remarks, appear to indulge in predictions, it is only guessing, not prophecy. I am entitled to guess, although not New England born, but I "*don't never prophesy unless I know.*"

Of the physical properties of the alternating current as they affect its use in power transmission, the most prominent are the following: First, its production by the generator and delivery to the motor without the use of a commutator. Second, the facility with which it can be transformed in its E. M. F., either upward or downward, by the use of simple apparatus. These points are in its favor. We notice, third, that inasmuch as an alternating current has its periods of zero E. M. F., its mean effective value is not the same as its maximum value. It follows that insulation of apparatus to use alternating currents must be calculated to withstand a higher potential difference than that available for virtual work. Fourth, we observe that the alternating current in its relation to conductors does not conform to Ohm's law in the elementary form, but to that law as amplified by the introduction of factors of periodicity, range of pulsation and inductance. The practical result of this is that to convey, under similar conditions, an equal amount of energy, the alternating current requires more copper than the direct current. This fact is not appreciated by the public, although it is familiar to engineers. Before the public the alternating current has been advertised as the current requiring little copper, whereas it may and does sometimes require, under practical conditions, 40 per cent. more copper than the direct current. The fifth physical property which we notice is nearly allied to the fourth. It is merely the fourth property in a special application. It is said that in circuits of great inductance, such as the winding of electromagnets, the alternating current is retarded in its development to such an extent that a great potential difference or a large current is required to produce magnetic effects which could be produced by direct current with much less apparent expenditure of energy. It is quite true that the expenditure of energy is apparent only, but that does not affect the fact that the windings, if the potential difference is to be kept low, must be of a conductor large enough to carry an enormous current without heating; or that, if the current is to be small, the insulation must be designed to withstand a great potential difference. A parallel observation is that the variable state of an electromagnet, which only exists at the moments of charge and discharge in a magnet excited by direct current, is continuous when the magnet is excited by an alternating current, and that the loss of power by hysteresis goes on continually in such a magnet.

Now, we must consider in the planning of any given transmission whether the good points of the alternating current do not outweigh the others which are to its disadvantage. In incandescence lighting this question has been answered in practice, and every day continues to be answered. We know that the answer given by practice is sometimes wrong, else we would not see direct current lighting stations located on the outskirts of towns and attempting to light their area at the cost of a large annual interest on copper; neither would we see alternating stations located in the middle of densely populated districts, and sacrificing efficiency on the greater part of their work in order that they may secure with the same system the revenue from a few distant lights. Still the problem is being solved, as such problems must finally be, by the daily progress of the world.

But the conditions of lighting do not correspond with those of power transmission. The advantages which outweigh the disadvantages of the alternating current for lighting purposes are not of so much value under other conditions. Thus, dispensing with the commutator on the alternator in a lighting station and substituting therefor a small self-exciting dynamo to charge the field, is a method both convenient and efficient. Then the lighting transformer, even at its lowest efficiency, is not such a wasteful device that it has not its proper use. But when we come to consider the transmission of power to a distant motor, the problem of how we are to excite the motor is a serious one; and when we look at the combination of alternator, exciter, step-up transformer at the generating station, plus step-down transformer, exciter and alternator, and some means of giving the alternator field its initial charge, all of which must be provided at the motor station, we are compelled to consider whether the simple, self-exciting direct current generator and the equally simple direct current motor are not to be preferred, even with their commutators, and their disadvantage that the E. M. F. to be used on the line must be employed also in the generator and the motor. And it is just those considerations that have so far retarded the development of alternating power transmission. For while the transmission of power by direct current has grown up, parallel with the development of direct current lighting, to tremendous proportions (as witness the use of motors on the circuits of all direct current stations, the magnificent developments of the electrical street car system and the transmissions of power to be found in all manufacturing and mining districts), there is, so far as my knowledge goes, only one alternating current transmission of power in the United States which can be considered to have passed the experimental stage. That is a transmission in Colorado by the synchronous method, which is doing the work it was set to do well and satisfactorily. Perhaps my statement that there is only one transmission is too sweeping. I make it subject to correction. I once incurred the wrath of a whole community in Nebraska by thoughtlessly saying in public that there was only one tree in town. Whereas it was well known to all reputable residents that besides the three which were in evidence on the Court House Square, there were also two cottonwoods growing out on section 35. I don't wish again to cause similar offense by unqualified statements.

There is nothing wrong with the synchronous method of transmitting power by alternating currents. True, it is necessary to start the motor by some exterior power, but if proper arrangements are made, the starting is no more difficult or tedious an operation than the starting up of a large Corliss steam plant. I think that the fifteen minutes before seven o'clock, which is usually devoted by a mill engineer to getting his engine and shafting into proper motion for the day's work, would be sufficient, if proper arrangements were made, to start up a synchronous motor. True it is also that the synchronous motor when overloaded "lies down" and declines to do any work at all until the load is reduced to what it considers its capacity. The same statement is correct, as every Sunday school child knows, regarding the model of animal power, the camel, and as any old soldier can tell concerning that much maligned carrier, the army mule; but it has not been imputed unto those animals for wickedness that they would not pull more than they thought they should; it has merely passed into proverb as "the nature of the beast." Then the synchronous alternating motor has an excellent quality in which is only equaled by the plain shunt wound motor of the every day electric light station: it regulates perfectly as to speed, keeping in step, within the limits of its capacity, with the generator which drives it.

And the synchronous motor is not the patented property of one inventor or corporation: it has belonged to the world ever since Dr. Hopkinson's experiments at North Foreland. There is not a company manufacturing alternate current machinery which would not gladly take an order for any number of synchronous power transmissions. The reason that there not an indefinite number of such transmissions in use is that the direct current motor stands ready to do the work under all conditions that have yet come up in practice. There is no long felt want waiting to be filled by a new method. The owners of water powers to-day who are considering electric transmissions can have their wants supplied by machinery of a type with which the electrical world is familiar and whose capabilities have been proven by long experience. Not that the synchronous method will not have its uses. It certainly will. Its possibilities are recognized by all engineers, and its day will come; but remember, the direct current motor has not reached its highest development. Its future is in good hands, and it will always, even under conditions most favorable to the alternator, be a competitor that cannot be disregarded.

There is another system of alternate current power transmission being developed, which has been aptly named the "multiphase method." It is a beautiful application of electrical laws, interesting to the lover of mathematics as much as to the engineer, for it has vast possibilities for analysis, and the production of graphic representations. It is not entirely new to the practical electric community. It has been applied to meters and to certain small motors.

The motors designed for multiphase currents are self-starting, self-exciting and not necessarily synchronous, so that they are free from difficulties which attend the synchronous method. They still are vexed with impedance and hysteresis; twin enemies of alternate apparatus, but not without hope. The lines along which the development of these motors must proceed are plainly marked out and they are certain to have their place in the future of power transmission. To-day they have no place. The brilliant experiment at Frankfort has not given us a commercially valuable method.

The absence of detailed data regarding all apparatus of this class limits me to some general observations, the first of which is that the weight efficiency of the class appears to be low—that it takes a multiphase machine much larger than the direct current machine required to do equal work. This we would anticipate from the use of the multiphase current in field magnets at low E. M. F. While the actual power absorbed is not excessive the current out of step with the E. M. F. is very large.

The next observation is that some multiphase designers are working on the problem of conversion of multiphase to direct currents. This seems a complicated process, but may have a commercial value, and indicates recognition of the desirability of direct currents.

The last observation is that the multiphase motors, and other motors excited by alternating currents, are apparently going to make their next step toward practicability by the assistance of condensers. This will cause a development of the condenser along commercial lines, akin to that which has produced the lighting transformers of to-day from the laboratory induction coil of yesterday. And in this will be a benefit to electrical apparatus at large.

Now to examine the difficulties under which direct current machines are said to labor. First of all there is the old story, the commutator, which it is said is a source of trouble at high potentials. I have made it my business to inquire regarding the behavior of every high potential commutator which I could hear of. The list, outside of the commutators of arc machines working up to 3,000 volts or so, is a small one, but I have heard of at least two commutators working with 5,000 volts and 10 ampères which gave no trouble, of an indefinite number of commutators working at 1,500 volts and 20 ampères which give no trouble, and of about a dozen working at 1,500 to 2,000 volts and 40 ampères which give no trouble. The record appeared to be the same all through. The commutator did not appear to be the weak part of the machine. You see none of these machines is a very large one. The reason I didn't get data about machines with outputs greater than 75 kilowatts is that I couldn't find any such machines working at high voltages. It is only lately that there have been large dynamos put in use in this country for any purpose, though there are now many at 500 and 1,000 volts. When a power transmission needs large machines of higher E. M. F. the machines will be ready, and the commutators will not give trouble.

Then we have the objection that high potential differences must be handled in direct current machines if economy of copper is to be secured on the lines. The alternate current transformer has the advantage in this respect, in that it is a stationary piece of apparatus whose construction admits of high insulation without material reduction of efficiency. And therein lies the certainty of the future development of alternating methods of transmission. There will come a few cases when the copper in the line will be a large factor in the total cost of the plant. These cases are far between. I have ascertained the proportion that copper bears to the total cost of line construction in a number of plants employing such E. M. F. as is common in direct current work. I am speaking of overhead lines now, the cheapest method of construction, and I find the percentage of copper cost is very small. Thus, in the cost of a mile of pole line, built in a workmanlike manner, with ordinary insulation, two wires being strung, the proportion of copper was 30 per cent. The remaining 70 per cent. represented poles, fittings, insulation and labor of construction. The proportion which this 30 per cent. of cost of pole line bore to the whole cost of the plant was very small. I have looked over the bills of actual expenditures on a number of pole lines, and over the estimates made by responsible contractors for many others, and I find that where a good line is built according to the idea of line construction generally prevalent in the United States, the copper is a comparatively small item of the line, and proportionately less in the whole cost of plant. But we cannot figure in power transmission work on using overhead lines, not even in the mountains, where there is no æsthetic sentiment to force the wires below the ground. The telegraph lines through the mining districts and others where water powers abound break down every winter under pressure of storms.

I need not show this assembly the visionary nature of schemes to carry the water power of Niagara to New York or Chicago. We will, any of us, undertake to do this if we receive the order from a responsible person, but we will each and all of us abstain from taking stock in the manufactories which depend on the transmitted power, and we will do this because we know that power transmitted means power lost in transmission, and that a difference of even three or four or five per cent. in the cost of power means the control or the loss of the market for

* A paper read before the Chicago Electric Club, Jan. 18, 1892.

manufactured goods in these days of sharp competition. The same commercial necessities which built up in the wilderness Rochester, Minneapolis and the towns on our own Fox River, away from the markets of their product, but near to cheap power—that same commercial necessity will limit the distance to which electrical power will ever be transmitted. It is not a question of engineering. It is a question of dollars and cents to the manufacturer.

Notes on the Distribution of Power by Alternating Currents.*

BY WM. STANLEY, JR.

For a number of years the electrical public have been looking forward to the production of a commercial alternating current motor. Up to this time the demand is unsatisfied, and a motor of this type is a thing unknown to the practical engineer. It is true that alternate currents have been utilized in a few instances to actuate synchronous and multiphase motors, but the difficulties arising in these problems have thus far prevented their general adoption. We are aware that the practical engineer has become skeptical of the realization in alternating current motors, and that all statements to the contrary notwithstanding he is apt to take inventors' certificates of their work "cum grano salis." For this reason in describing to you some of our work on alternating current motors, we shall simply invite your criticisms of the methods employed, their practical value, and their usefulness to the engineer, and shall leave your minds free to accept or reject them on this evidence. The motor will soon be placed on the market, and may then be judged by its practical operation.

It has appeared necessary to us that any system of power distribution by alternating currents of electricity to be commercially should be operated on the existing systems of current supply, viz.: the multiple transformer system of standard frequency.

In order to produce a motor to fit these conditions we have studied an ordinary continuous current motor when supplied with alternating currents, for it is evident that if the electrical reactions produced by alternating currents in a motor are similar to those produced by continuous currents, the problem would be a comparatively simple one. In pursuing this problem many difficulties have arisen requiring special investigation and treatment, so that while the finished motor operates about as well on alternate as on continuous currents, the steps by which these results were attained have been both difficult and laborious.

The motor now to be described is the invention of Mr. William Stanley, Jr., and Mr. John F. Kelly, and is the outgrowth of a motor described by them in the electrical papers some time since,† in which a condenser is used in the field circuit. The present form makes use of the condenser, and embodies several important improvements.

In general the motor is of the two or four pole type (although the number of poles is not restricted) having a well laminated field and armature. The field coils are of comparatively few turns, which may be placed on the poles as in the ordinary type of direct current motor, and are connected either in series or multiple, through a condenser, to a source of alternating current.

The armature is of a specially wound closed circuit type, having an ordinary Gramme commutator on which bear two brushes placed on the neutral line or lines. These brushes are connected to the source of alternating current supply. The transformer furnishing current to the shunt type of motor has two secondaries, one of which supplies the field with a constant current, while the other supplies a variable current to the armature.

Before taking up the description of the motor in detail, let us see the effect of applying an alternating E. M. F. to a continuous current shunt wound motor.

We will consider a motor wound with 3,000 turns on its field, which when in circuit furnishes the necessary magnetizing power of 500,000 C. G. S. lines of magnetism through the armature. Just as in a transformer the reactive effect of the magnetism on the primary coil develops a counter E. M. F. of self-induction, so also the effect of the field magnetism on the field coils develops a counter E. M. F. which practically annihilates the impressed E. M. F., and by preventing nearly all the current from flowing through the field circuit greatly reduces the magnetism.

It is of course possible to apply a sufficiently high E. M. F. to give the required field magnetization, but a brief calculation shows that, under the conditions assumed, this E. M. F. would be about 9,000 volts, a pressure entirely out of the question. The magnetization set up through a given circuit is approximately proportional to the product of the number of turns and the current, viz.: the ampère turns, which product may of course be obtained with a fewer number of turns and a larger current. This has an important bearing in reducing the applied E. M. F. on the field. Instead of 3,000 turns suppose we take 250; to give the same magnetization the current will have to be twelve times as great, and calculation shows the necessary E. M. F. to be about 750 volts. Fortunately it is not necessary to employ this as an impressed E. M. F. from the transformer, for by inserting into the field circuit a condenser of proper size (dependent on the number of alternations, the reluctance of the circuit, the turns, etc.) there is developed an E. M. F. between the condenser terminals that always opposes the E. M. F. of self-induction in time and value, and destroys all effects of self-induction, allowing the same amount of current to flow as if the circuit were supplied with a continuous current, neglecting of course losses due to extra apparent resistance by hysteresis and Foucault currents. By inserting a condenser in the field circuit any low E. M. F., as 100 volts, may be used to magnetize the field, thus obviating the use of high potentials. The employment of the condenser has also the advantage of reducing the lag of the current behind the applied E. M. F., a result which would take place if a field E. M. F. of 750 volts were used, and no condenser was in circuit. Thus two of the difficulties of operating a motor by alternating currents are overcome; 1st, that of obtaining the required magnetization to flux the field without employing a high E. M. F.; 2d, that of causing this magnetization to occur at the proper time, viz., in phase with the E. M. F. applied.

Imagine a motor magnetized as described, having an alternate current applied to its armature; there will be a lag of the current in the armature behind its E. M. F., as was the case of the field current. To give the maximum amount of power and torque for given values of currents in the field and armature they must flow in unison; for if there be a lag between the field magnetization and armature current, during that part of an alternation in which the currents coincide the pull will be in one direction, and during that part of the alternation in which the currents are opposed the pull will be reversed. To overcome this difficulty we have wound about the armature parallel to the direction of the field magnetization a number of short circuited coils sunk in slots in the field poles.

This short circuited winding is only acted upon by the current in the armature coils, and as a short circuit in the secondary coil of a transformer destroys the self-induction of the primary circuit, so the currents inducted by the armature current in the short circuited coils reduce the self-induction of the armature coils, and consequently lag in the armature current, and bring it in phase with the applied E. M. F. Clearly the E. M. Fs. applied to the field and armature coincide (because they come from the same transformer), and as there is no lag in either the field or armature current, it is evident that the field magnetization and armature current must coincide, and that the torque of the motor must always be in one direction. Thus another difficulty is removed. Aside from the difficulties mentioned many others have arisen requiring much special attention. These have mostly been remedied by the careful designing and proportioning of the various parts, although the problem of getting a good, durable and cheap form of condenser has been a long study by itself.

If a motor made as described be supplied with alternating currents it will start from rest with the same torque as if supplied with continuous currents. If it is run free of load the current in the armature will be small, and as load on it is increased the current in the armature will increase in like proportion. In short, it will behave exactly like a continuous current motor.

Supplied thus with a motor for alternating currents meeting all the requirements demanded of a continuous current motor, we are required to show the advantages of the alternate system of motor supply.

It is not necessary to impress on you the advantages of the alternating current system of distribution over any other yet devised, and while this system as at present used has greatly advanced the distribution of electricity from central stations, it is nevertheless a fact that the greatest difficulty in distributing from large stations is the cost and maintenance of the working feeders. The cost of feeders for distributing current from large stations is often greater than the cost of the station equipment, and the feeders are even then inadequate to the demands made upon them.

For the moment it will be advisable to assume the responsibility of designing a station and system of distribution which shall furnish the required currents for the heart of a large city, and in assuming that a single station is to be equipped to deliver currents for 100,000 16 c. p. lamps, and for 10,000 h. p. of motor service, we are assuming conditions which will approximately fill the requirements of many large stations that are now entirely unable to meet the demands made upon them.

Assuming conditions of this magnitude we are to find out if they can be met by apparatus now devised by the engineering profession. There are at present in this country several builders of engines who can furnish triple expansion engines of 1,000 h. p. each. With each of these engines 10,000 16 c. p. lamps can be run. A station designed for 20 such engines would require no special engineering skill, except as to the supply of its fuel and the removal of its ash. Imagine a station equipped with 20 such engines capable of simultaneously developing 20,000 h. p. To each engine let there be directly belted two 5,000-light (250,000 watt) dynamos, each dynamo operating at 5,000 volts E. M. F.; there will then be 40 dynamos, from each of which a single feeder connected through a modern switchboard will be led out. Each feeder when fully loaded will then carry 50 ampères at, say, 5,500 volts. We estimate that 40 such feeders can be made to deliver a maximum load of 100,000 16 c. p. lamps and from 10 to 15,000 h. p. of motor power.

It can be shown that with a potential of 5,000 volts the cost of copper mains for distances not exceeding 2,000 yards from a station is comparatively insignificant, so that if this voltage be applied it will greatly reduce the outlay for and care of the underground work.

Thus far our problem is simply one depending upon the necessary capital forthcoming to construct the work and purchase the apparatus. The question next arising is, how shall the 5,000 volt alternate currents generated be safely transformed? The first thing to do is to lease a number of cellars, say ten, lying at the heart of the electric service. Each cellar is to be entered by two or more feeders; connected to the feeders by and through proper switchboards are large transformers of at least 50,000 watts, or one thousand lights, capacity each. If the cellar or sub-station is to furnish its surrounding territory with 10,000 lights, ten transformers of one thousand lights capacity each would be installed; the primaries of these transformers to be connected to a common feeder entering the sub-station, whose duplicate is at hand in case of accident to the mains. From the secondaries of these sub-transformers circuits at 1,000 volt potential lead through a switchboard to the service mains.

The advantages of this method of distribution over the ordinary single conversion method is very great, not only is there a separate transformer insulation between the station and the consumer, with abundant opportunity to test and keep clear the underground work, but as the load upon the station is indicated at each sub-station, the attendant can insert or remove the transformers from circuit according to the variations of load. As the efficiency of the system will depend largely upon the efficiency of the apparatus exterior to the station, and to some extent upon the efficiency of these sub-station transformers, it may be well to give a few figures on the losses found in electromagnetic apparatus, such as transformers or motors when they are actuated by alternate currents.

Neglecting the losses that occur in large masses of metal carrying alternate currents, such as thick copper mains, it can be shown that alternate currents principally waste energy when they are called upon to produce strong magnetic forces, and that these losses are a serious matter unless proper precautions are taken to avoid them.

An extended series of tests on many samples of the best steel and iron determine that when the magnetization exceeds 30,000 C. G. S. lines per square inch the losses in the iron increase much more rapidly than the magnetization obtained, and that the most economical point to work good iron magnetically is at a loss of about one watt per pound. This of course is not an inflexible rule, but it is a safe and fairly accurate conclusion. Under this rule, therefore, if a transformer or motor magnetized to the proper degree has a flux conveying core that weighs 100 pounds, then so long as it is in operation it will continuously lose 100 watts. If the core magnetized weighed 250 pounds, there would be a continuous waste of 250 watts, etc.

Let us apply these figures to the efficiency of these sub-station transformers.

The core of a 20-light transformer weighs from 40 to 100 pounds and wastes from 45 to 120 watts, or at least 2 watts per lamp. A 100-light transformer core weighs 100 pounds, and wastes continuously 100 watts, or 1 watt per lamp. A 300-light transformer core weighs 200 pounds, and has a minimum loss of 200 watts or .66 watts per light. A 1,000-light transformer core will lose about 500 watts or .5 of a watt per light, so that the iron loss in ten sub-station transformers of 1,000 lights capacity each, or 10,000 lights capacity total, would be 5,000 watts or 1 per cent. of their output. The loss in the copper circuits of these transformers would not exceed 1 per cent., and thus the total efficiency of the large sub-station transformers would be approximately 98 per cent. at full load, and 93 or 94 per cent. at one-quarter load. There is no particular difficulty in building these large transformers to have this very high efficiency.

Finally, in summing up the subject we wish once more to emphasize the complete flexibility of the alternating current system of light and power distribution. In the station the advantages of the alternating system at once make themselves apparent by the simplicity of equipment.

Granting that the efficiency of the alternating current dynamo does not exceed that of the direct current machine, it is at least fair to assume them on a par. The number of feeders are few, their size small, and the consequent first cost insignificant, as compared with feeders for direct current to transmit the same amount of energy. Aside from first cost the cheap maintenance of subways should be considered. The efficiency of the system from station to consumer may readily be 90 per cent. for very considerable distances, if properly designed.

Lastly to be considered is the complete adaptability of motors on feeders furnishing current at great distances from the source of supply, which with direct currents is an impossibility, for if direct currents were used the E. M. F. necessary at the motors would be up in the thousands of volts, in order that the cost of the mains should not prohibit their being laid. This is a higher E. M. F. than can be used with commercial success, and is also attended with great danger.

On the other hand, with the alternating current the transmission of energy may be at high voltages, and its use as light and power may by transformation be at as low an E. M. F. as 100 volts. Consequently use the alternating current system where any considerable amount of light and power are required.

* A paper read before the Chicago Electric Club, Jan. 18, 1892.
† See The Electrical World June 13 and Oct. 10, 1891.

On the Law of Hysteresis.—II.*

BY CHAS. PROTEUS STEINMETZ.

The operation of the instrument is exceedingly simple and is as follows: Into the coil C an electric current is sent which is measured by the ammeter A, and regulated by the resistance switch R. Then the needle, which before had no fixed position, points to zero.

Now the magnetic standard, consisting of a cylindrical piece of Norway iron of 4 cm.² cross section and 20 cm. length is laid against the back of the instrument, with both ends fitted into holes in large blocks of Norway iron, A_3 A_4, which are laid against the poles S_1 N of the magnetometer so that the transient resistance from pole-face to iron is eliminated.

The sample of iron that we wish to examine is turned off to exactly the same size, 4 cm.² cross-section and 20 cm. length, and fitted into blocks A_1 A_2 in front of the magnetometer. Then so many fractional standard pieces of Norway iron are added in front that the needle of the instrument points to zero. This means that the 4 cm.² Norway iron in the back carry, under the same difference of magnetic potential, the same magnetism as the 4 cm.² of the examined sample plus the x cm.² of fractional standard, added in the front. Hence, 4 cm.² of the examined sample are equal in conductivity (susceptibility) to $(4 - x)$ cm.² of Norway iron, and the susceptibility of this sample is $\frac{4-x}{4} \times 100$ per cent. of that of Norway iron, for that difference of magnetic potential, viz., magnetization, that corresponds to the magnetometer current.

To get absolute values, the instrument has been calibrated in the following way: In the front and in the back the magnetic circuit of the instrument has been closed by 4 cm.² Norway iron. Then another piece of iron, and of any desired size, has been added in the front. This piece, y, carrying some magnetism also, equilibrium was disturbed. Then through a coil of exactly 110 turns, surrounding this piece y, an electric current i was sent and regulated so that equilibrium was restored. In this case no magnetism passed through y, or in other words, the M. M. F. of the current i; 110 i ampère turns is equal to the differences of magnetic potential between the pole-faces of the instrument. In this way, for any strength of current in the main coil C of the magnetometer, the difference of magnetic potential produced thereby between the pole-faces of the instrument was determined and plotted in a curve, for convenience, in ampère turns per cm. length.

Now, the Norway iron standard was compared on the magnetometer with sheet iron, of which, from tests with low frequency alternating currents, the magnetization corresponding to any M. M. F. was known, and therefrom derived the magnetic characteristic of the Norway iron standard, and plotted in a curve also.

In the way explained before the iron sample that was to be determined was balanced by the magnetometer by Norway iron, thereby giving its susceptibility in per cent. of that of the Norway iron standard, the magnetometer current read, from the curves taking the M. M. F. corresponding thereto—denoted with F—and the magnetization of the Norway iron, corresponding to this M. M. F., F, and from the determined percentage of susceptibility of the examined sample, the magnetization B of this sample corresponding to the M. M. F. F.

With this instrument a number of magnetic cycles of different samples of steel and cast iron were determined.

First, a powerful alternating current was sent through the magnetometer and around all the iron pieces used, to destroy any trace of permanent or remanent magnetism.

Then the examined sample was laid against the front, the standard against the back of the magnetometer, balanced, and a larger number of magnetic cycles completed between given limits, for instance, + 95 and — 95 ampère turns M. M. F. per centimetre length. Then readings were taken from maximum M. M. F. + 95 down to zero, and again up to the maximum — 95, down over zero and up to + 95, thereby completing a whole magnetic cycle, and then of a second magnetic cycle, a few readings were taken as check for the first one.

In this way for different M. M. Fs. the curve of hysteresis was found, and by measuring its area the loss by hysteresis determined.

The further calculation was done in a somewhat different way. Generally the number of cycles was not large enough to determine conveniently the exponent by analytical methods.

Therefore the law of the 1.6 M. power:

$$H = \eta B^{1.6}$$

was assumed as true, and for each cycle from the known values of H and B determined the co-efficient η.

If for different cycles the values of η agreed, this would prove the assumption, the correctness of the law of 1.6th power, while a disagreement would disprove it.

In the following for a number of samples the magnetic cycles are given:

F = M. M. F., in ampère turns per centimetre length.

B_r and B_d = the intensity of magnetization, in kilolines, corresponding to M. M. F. F, for the rising and the decreasing branch of the magnetic curve.

The area of the looped curve, representing the loss of energy by hysteresis, is derived by adding the values of B_d, and subtracting therefrom the sum of the values B_r, B_1 and B_r, being given from 5 to 5 ampère turns, or .5 absolute units, the difference of the sums of $B_d - B_r$ just gives the loss by hysteresis, in ergs per cycle.

CAST STEEL, ANNEALED AND HARDENED.

Of one kind of steel, two test pieces were cast, at the same casting, turned off to standard size, and by comparing them in the magnetometer found to be exactly alike.

Then the one piece was hardened, the other left annealed.

Magnetometer tests gave the following magnetic cycles:

TABLE VI.

	Hardened.			Annealed.	
F.	B_r B_d	B_r B_d	B_r B_d	B_r B_d	B_r B_d
0	± 5.0	± 7.0	± 7.8	± 6.6	± 8.6
5	− 4.4 +5.6	− 6.4 + 7.5	− 7.3 + 8.2	− 1.4 +10.7	− 2.6 +11 3
10	− 3.7 6 1	− 5.6 7.9	− 6.8 8.6	+ 3.4 11.9	+ 3.7 12.3
15	− 2.7 6 5	− 4.4 8.2	− 5.6 8.9	8 4 12.5	8.4 12.7
20	0 6 9	− 1.9 8 6	− 2.3 9.2	10 9 12 8	10.8 13.0
25	+ 3.9 7.3	+ 1.9 9.0	+ .4 9.5	12 2 13.1	12 0 13.3
30	5.5 7.6	4.2 9.3	2.5 9.8	13.0 13.4	12.7 13.6
35	6.7 8.0	6.2 9.6	4.2 10 1	13.5 13 7	13.2 13.9
40	7.7 8.3	7.6 9.9	5.8 10 4	13.9 14.0	13.5 14.2
45	8.5	8.7 10.2	7.2 10.7	14.1	13 8 14.5
50	(44.5.)	9.6 10.5	8.4 11.0	(44.5.)	14 1 14.7
55		10.4 10.8	9 6 11.2		14.4 15 0
60		10.9 11.1	10.4 11.5		14.7 15 2
65		11.4	10.9 11 8		15.0 15.4
70		(64.5.)	11.4 12.0		15 3 15.6
75			11.9 12.3		15.6 15 8
80			12.2 12 5		15.8 16 0
85			12.5 12.7		16.0 16.1
90			12.8 12.9		16.2 16.3
95			13.0 13.1		16 4 16.5
100			13.2 13 3		16.6
105			13.4 13.4		(101.0.)
110			13.5		
			(108.0.)		
H = obs.	48,300	77,800	101,100	34,800	45,000

Herefrom as coefficient of hysteresis, was found

η = .02494 | .02512 | .02490 | .007997 | .007962

Average, η = .024987 ~ .025; η = .007980 ~ .0080

Hence, when annealed, the hysteretic loss is

$$H = .008\ B^{1.6}$$

when hardened

$$H = .025\ B^{1.6}$$

and calculated by means of these formulas, we derive

H calc. =	48,400	77,500	101,500	34,730	45,100
and H calc. − H obs. =	+ 100	− 300	+ 400	− 70	+ 100
= per cent. of H calc.	+ .2	− .4	+ .4	− .2	+ .2

Another sample of cast steel of low susceptibility gave:

Average, η = .001195 ~ .012

Herefrom, $H = .012\ B^{1.6}$

H calc. =	14,620	19,520	25,140	30,020
H calc. − H obs. =	+ 20	− 380	+ 140	+ 420
= per cent. of H calc.	+ .1	− 1.9	+ .6	+ 1.4

With regard to hysteresis, this kind of cast steel is 50 per cent. worse than the annealed cast steel No. 1, but still twice as good as the hardened sample. But, magnetically, it is poor—that is, of low susceptibility, giving for 40 ampère turns M. M. F. per centimetre length only ~ 6,600 lines of magnetic force per square centimetre, while the annealed steel gives ~ 14,000—that is, more than twice as many, and even the hardened steel gives more ~ 8,000.

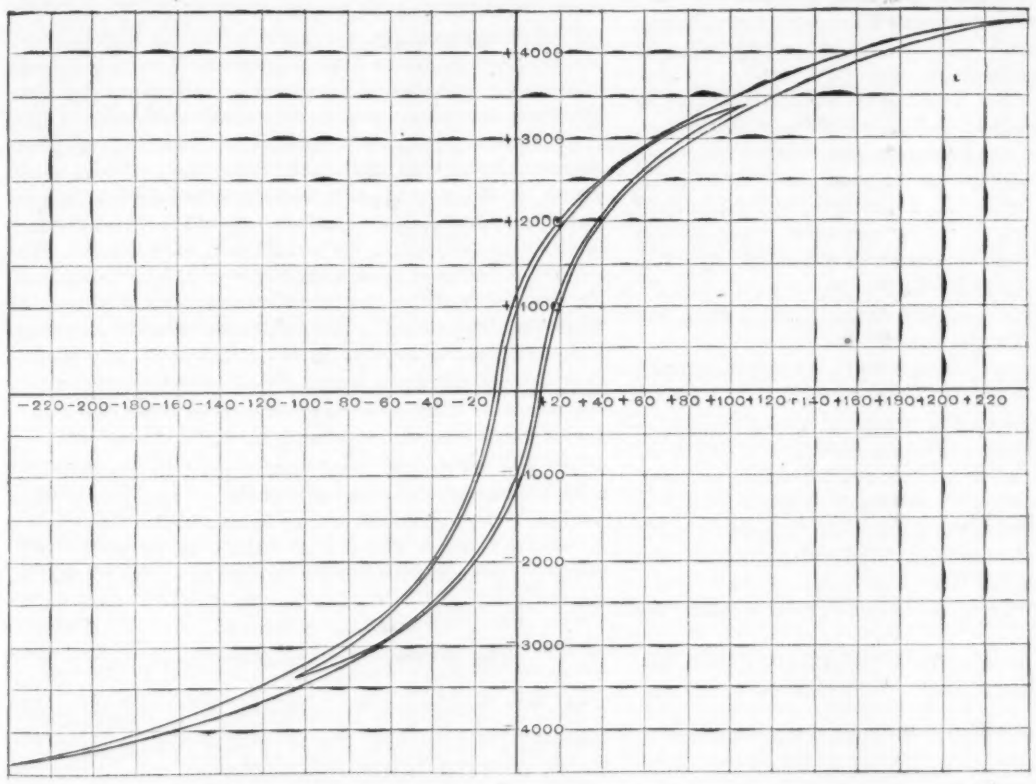

FIG. 4.—STEINMETZ CURVES OF HYSTERESIS.

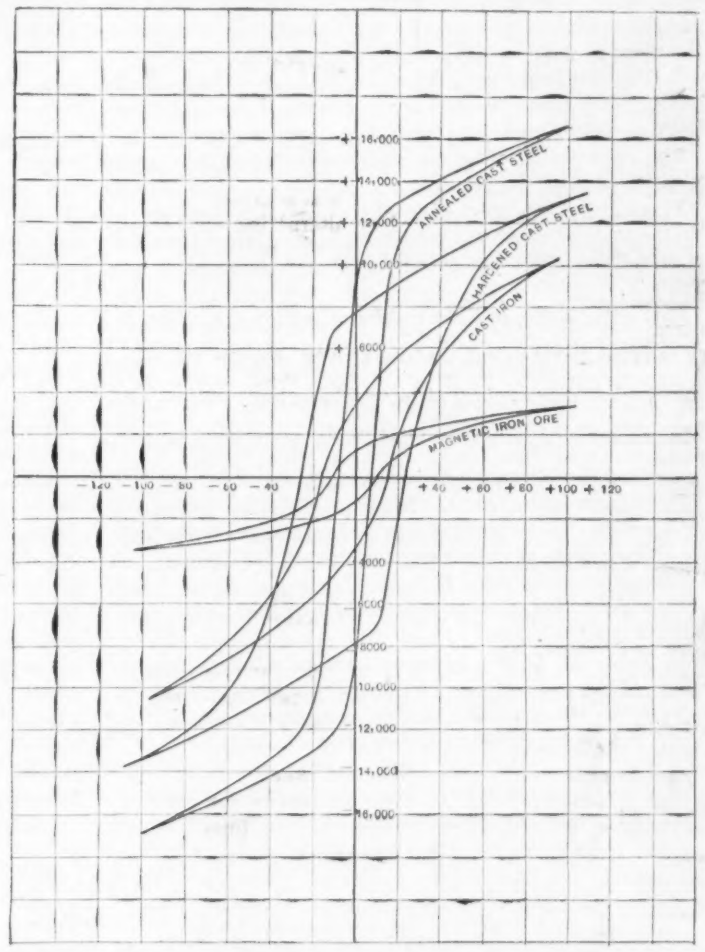

FIG. 5.—STEINMETZ CURVES OF HYSTERESIS.

In Table VII. and Fig. 4 are given the magnetic curves of a piece of magnetic iron ore, apparently pure Fe_3O_4 of the dimensions, 1 in. × 1 in. × $2\frac{21}{32}$ in.

TABLE VII.

MAGNETIC CHARACTERISTIC.

F in ampère turns per centimetre length of magnetic circuit.
B in lines of magnetic force per square centimetre.

F	B	F	B	F	B
10	750	70	2,930	140	3,770
20	1,510	80	3,080	160	3,930
30	2,000	90	3,220	180	4,070
40	2,320	100	3,350	200	4,200
50	2,560	110	3,470	220	4,310
60	2,760	120	3,580	240	4,400

TABLE VIII.

CYCLIC MAGNETIZATION.

	I		II.		II.		
F	B_r	B_d	B_r	B_d	F	B_r	B_d
0		±900		±1,020	130	3,640	3,740
10	0	+1,520	−200	+1,660	140	3,730	3,820
20	+1,200	1,920	+1,000	2,020	150	3,820	3,900
30	1,800	2.230	1,750	2,280	160	3,910	3,980
40	2,160	2,500	2,150	2,520	170	3,990	4,050
50	2,450	2,700	2,390	2,710	180	4,050	4,110
60	2,670	2,850	2,610	2,880	190	4,120	4,170
70	2,850	3,000	2,800	3,020	200	4,190	4,230
80	3,020	3,120	2,980	3,150	210	4,250	4,280
90	3,190	3,250	3,140	3,280	220	4,320	4,340
100	3,340	3,360	3,280	3,410	230	4,360	4,370
110	3,440		3,410	3,530	240	4,400	
120	(106.)		3,530	3,640		(240.)	

* Abstract of a paper read before the Am. Inst. of Elec. Eng.

$H_{obs.}$ = 9,340 ergs 13,780 ergs

η = .02049 .02041

Average, η = .02045

Curve of hysteresis,

$$H = .02045\ B^{1.6}$$

$H_{calc.}$ = 9,320 ergs 13,810 ergs

$H_{calc.} - H_{obs.}$ = — 20 ergs + 30 ergs

= — .2 per cent. + .2 per cent.

As seen, the coefficient of hysteresis of magnetic iron ore, η = .020, ranges between that of cast-iron, η = .016, and of hardened steel, η = .025.

The magnetic conductivity is approximately 20 per cent. of that of wrought iron.

In Fig. 5 is given a comparison of the hysteretic curves of—

Hardened steel,
Annealed steel,
Cast iron,
Magnetic iron ore,
in the same size.

This figure shows well the three characteristic forms of hysteretic curves.

1. The hardened steel curve of high coercitive force has the bend or "knee" on the negative side, so that for zero M. M. F. the "remanent" magnetism is still in the saturation part of the curve—that is, in stable equilibrium; therefore permanently maznetizable.

2. The soft iron curve, with the bend on the positive side, so that for zero M. M. F. the "remanent" magnetism, though still very high, is already below the range of saturation, on the branch of unstable equilibre. Therefore the remanent magnetism is very unstable and easily destroyed, the more as the coercitive force is very small.

3. The cast iron curve, which has no marked knee at all, but a steady curvature of low remanent magnetization, but with regard to coercitive force ranging between 1 and 2.

The curve of the magnetic iron ore shows all the characteristics of a cast iron curve.

Having derived, now, a larger number of values of the hysteretic coefficient η for different kinds of iron and other material, we shall put them together for comparison in Table X.

It is remarkable, in these results, that for several samples of each set the quotient $\frac{\eta}{C}$ gives almost exactly the same value, while other values disagree therefrom. From this average value of $\frac{\eta}{C}$ are calculated the values of the coercitive force C of sheet iron, given in the brackets.

For convenience, in the following table are given the values W of consumption of energy in watts per cubic inch, for 100 complete periods (magnetic cycles) per second, and for the magnetization of H lines of force per square inch, giving as coefficient of hysteretic resistance the value $r = 8.3 \times 10^{-6}\ \eta$.

In Table XI. I have given a number of experimental values of the consumption of energy by hysteresis and believe to have shown that this consumption of energy can fairly well be expressed by the empirical formula,

$$H = \eta B^x$$

where the exponent x is equal, or at least very nearly, to 1.6, and the coefficient η a constant of the material, which

η denotes the coefficient of hysteresis.

B the maximum magnetization in lines of magnetic force per square centimetre.

R the remanent magnetization in lines of magnetic force per square centimetre.

TABLE X.

$H = \eta\ B^{1.6}\ [+\ \varepsilon\ N\ B_2]$.

H in ergs per cycle and cm.³, B in lines of magnetic force per cm.², F in ampère turns per cm.

Material.	Hysteretic Coefficient η	Magnetization at the M. M. F. F = 10	= 40	= 90	Residual Magnetism R. For F = 40	= 90	Coercitive Force C. For F = 40	= 90	F = 40	$\frac{\eta}{C}$ for 90.
Very soft iron wire (Ewing)	.0020	12,800	14,700	16,600			(1.5) ¶	(1.9)		
Westinghouse converter, sheet iron	.0024	14,400	17,800	20,800			(1.8)	(2.0)		
Very thin sheet iron, standard	.0030 *	13,100	17,100	20,700			(2.3)	(2.8)		
Thick sheet iron	.00333 †	13,100	17,500	.....			(2.5)	(3.1)		
Sheet iron	.00421 ‡	... .	.....	.....			(3.2)	(3.9)		
Sheet iron	.00450 §	.....	.....	. ...			(3.4)	(4.2)		
Soft annealed cast steel	.0080	7,800 ‖	14,000	16,300	5,100	8,200	6.0	7.0	.00133	.00114
Tool steel	.0094	5,800	14,800	18,800	8,300	9,600	9.1	11.1	.00103 **	.00085 *
Cast steel of low susceptibility	.0120	2,000	6,400	9,800	2,600	3,300	9.1	11.6	.00132	.00104
Cast iron	.0162	1,600	6,100	10,100	2,100	3,400	10.4	15.2	.00156 **	.00106
Hardened cast steel	.0250	1,200	8,000	12,900	4,500	7,200	19.0	23.5	.00132	.00107
Magnetic iron ore	.02045	.750	2,320	3,220		900		10.0		.00204
							Average		.00132	.00108

*, For N = 100. †, $\varepsilon = .746 \times 10^{-6}$. ‡, $\varepsilon = .2083 \times 10^{-6}$. §, $\varepsilon = 1.16 \times 10^{-6}$. ‖, This, and the following values of this column are derived as average of rising and decreasing branch of the magnetic characteristic, because at F = 10 the magnetism is still very unstable. ¶, Computed by means of the average values of $\frac{\eta}{C}$ .00 132 and .00 108. ** Left out by taking the average of $\frac{\eta}{C}$

TABLE IX.

Material.	Condition.	η	B	R
Wrought iron	Annealed	.00202	18,250	7,250
Soft Bessemer steel	.045 per cent. C annealed	.00262	18,200	7,860
Soft Whitworth steel	.09 " " "	.00257	19,840	7,080
	.32 " " "	.00598	18,740	9,840
	.89 " " "	.00786	16,120	10,740
	.32 " " oil-hard.	.00954	18,800	11,040
	.89 " " "	.01844	16,120	8,740
Silicon steel	3.44 " Si, wrought	.00987	15,150	11,070
	3.44 " " annealed	.00784	14,700	8,150
	3.44 " " oil-hard.	.01282	14,700	8,080
Manganese steel	4.73 " Mn, wrought	.05963	4,620	220
	8.74 " " "	.....	747	.....
	12.36 " " "	.....	310	..
	4.73 " " annealed	.04146	10,580	5,850
	8.74 " " "	.08184	1,985	540
	4.73 " " oil-hard.	.06706	4,770	2,160
	8.74 " " "	.....	788	.....
Chrome steel	.62 " Cr, wrought	.01179	15,780	9,320
	1.2 " " "	.01851	14,680	7,570
	.62 " " annealed	.00897	11,850	7,570
	1.2 " " "	.01638	13,230	6,490
	.62 " " oil-hard.	.03958	13,960	8,600
	1.2 " " "	.04442	12,870	7,890
Tungsten steel	4.65 " Wo, wrought	.01516	15,720	10,140
	4.65 " " annealed	.01435	16,500	11,010
	3.44 " " oil-hard.	.04776	14,480	8,640
	2.35 " " very hard	.05778	12,130	6,820
Gray cast iron	3.45 p. c. C; 17 p. c. Mn	.01826	9,150	3,160
White cast iron	2.04 " C; 34 " "	.01616	9,340	5,550
" "	4.5 " C; 8.0 " "	.....	385	77

These values of the hysteretic resistance vary from .002 up to .082, 41 times the first value.

But especially marked is the fact that η depends much less upon the chemical constitution of the iron than upon its physical condition, annealing decreasing, and hardening increasing the hysteresis very considerably.

So far as the chemical constitution is concerned, the purer the iron the lower is its hysteresis, while any kind of foreign matter increases the hysteresis. Especially manganese increases the hysteretic loss enormously, much less wolfram and chromium, least silicon and carbon. Connected with the increase of hysteresis is always a decrease in susceptibility.

I wish to add a few remarks on two alleged phenomena connected with hysteresis, which have been talked about considerably, without yet being made clear; the decrease of hysteresis for open magnetic circuit, and the decrease of hysteresis of a transformer with increasing load.

With regard to the first, as shown, actual tests do not show a smaller value of hysteresis for open than for closed magnetic circuit.

And it cannot be understood how that could be.

For consider an iron molecule of the magnetic circuit exposed to the harmonically varying M. M. F. and performing a magnetic cycle. Evidently it can make no difference for this iron molecule, whether some trillion molecules farther away the magnetic circuit ends in air, or is closed entirely in iron, supposed that the M. M. F. and the magnetism, and therefore also the magnetic reluctance, are the same in both cases.

Neither can it make any difference whether the M. M. F. is caused only by one sine wave of electric current, or is the resultant of several M. M. Fs., as in the loaded transformer. It is the same as with the electric current, where the energy converted into heat in each molecule of the conductor does not depend upon whether the material of the conductor on some other point changes, or whether one or more E. M. Fs. are acting upon the circuit.

Hence, until absolutely exact and undoubtable determinations of the hysteretic loss for fully loaded transformers are at hand, the assumption of a decrease of hysteresis with increasing load must be rejected.

That an apparent decrease with increasing load has been observed several times may be conceded, for besides the exceedingly great liability to errors in these tests, where the hysteretic loss comes out as the small difference of two large values, primary energy and secondary energy, and therefore is very much affected by the slightest error in any one of the components, it must be understood that the main possible errors in the determinations on fully loaded transformers all point this way. Neglect of secondary self-induction, decrease of magnetization with increasing load, slowing down of the dynamo alternator, etc., all cause an apparent decrease in the hysteretic loss for increasing load.

To combine the results, what I believed to be proved is that loss of energy in iron caused by reversals of magnetism can be expressed by the analytical formula:

$$H = \eta B^{1.6}\ \varepsilon\ N B^2,$$

where η is the coefficient of hysteresis, ε the coefficient of eddy currents, N the frequency of the alternations of magnetism, $\eta\ B^{1.6}$ the loss of energy by hysteresis proper, or by molecular friction and $\varepsilon\ N.\ B^2$ the loss of energy by eddy currents, per magnetic cycle and per cm.³ proportional to the frequency N.

TABLE XI.

$W = \gamma\ H^{1.6}$.

W in watts per cubic inch and 100 complete periods per second.
H in lines of magnetic force per square inch.

	γ	H = 10,000	20,000	30,000	40,000	50,000	60,000	70,000	80,000	90,000	100,000	110,000	120,000	150,000
	166×10^{-10}	W = .042	.13	.24	.38	.55	.73	.94	1.16	1.40	1.66	1.94	2.23	3.18
Westingh'se conv'rter, sheet iron	201	.051	.15	.29	.46	.66	.89	1.14	1.41	1.70	2.01	2.34	2.69	3.84
Very thin sheet iron	249	.063	.19	.36	.58	.82	1.10	1.41	1.74	2.11	2.49	2.90	3.34	4.77
Thick sheet iron	277	.070	.21	.40	.64	.91	1.22	1.56	1.94	2.34	2.77	3.22	3.71	5.30
Sheet iron	350	.089	.27	.50	.81	1.15	1.55	1.98	2.45	2.96	3.50	4.07	4.69	6.69
Sheet iron	374	.095	.29	.54	.87	1.23	1.66	2.12	2.62	3.17	3.75	4.36	5.02	7.17
Soft annealed cast steel	663	.17	.51	97	1.53	2.19	2.93	3.75	4.64	5.60	6.63	7.73	8.88	12.7
Tool steel, soft	778	.20	.59	1.14	1.80	2.57	3.44	4.40	5.45	6.57	7.78	9.06	10.4	14.9
Cast steel of low susceptibility	994	.25	.76	1.45	2 30	3.28	4.39	5.62	6.95	8.39	9.94	11.6	13.3	19.0
Cast iron	1,346	.34	1.02	1.96	3.11	4.44	5.94	7.60	9 41	10.9	13.4	15.7	17.6	25.8
Hardened cast steel	2,077	.52	1.58	3.03	4.80	6.85	9.18	11.7	14.6	17.5	20.7	24.2	27.8	39.8

H = 25,000; alternate current transformer, American style (high frequency).
H = 35,000; " " " " European " low "

Only the values smaller than .25 W can be of practical use; in those larger than 10 the iron gets at least red hot if in larger quantities.

ranges from .002 up to .025 and more, and may possibly have a slight dependence upon the velocity wherewith the magnetic cycle is performed, as the second set of alternate current reading seems to indicate.

In Table IX I give the values of the hysteretic resistance η for some iron samples, subjected to a magnetic cycle between F = + 190 and — 190 ampère turns per centimetre, calculated from Hopkinson's tests * by the assumption of the law of hysteresis.

* From "Kalender fur Electrotechniker," by Uppenborn, Berlin, Germany.

The Storage Battery at Dubuque, Ia.

Mr. J. A. Rhomberg, president of the Dubuque Street Railway Company, in a recent interview, pronounces the storage battery a failure, and gives some facts in support of his claim, some of which are as follows:

"We commenced running the six cars on or about May 29, 1891, and to our knowledge the batteries had already begun to give way at about the beginning of July, of which I at once notified the Accumulator company. The Accumulator company had three of their own electricians here to superintend the whole plant from the very beginning up to Dec. 1, excepting a couple of weeks, when there was only one, and one electrician until after Jan. 1, 1892. These three electricians were operating the plant; they were looking after the batteries, of which they had full charge, and they had likewise entire control over the men that handled the batteries, whereas during all this time we had nothing whatever to do with the batteries.

"The results since have shown that it is utterly impossible to make it a success, as the second and also the third set of positive plates have given out in almost the same way as the first, notwithstanding the fact that they were treated quite differently from the first set, they being permitted to make only one and two trips, or six to twelve miles, with one charge, whereas the first sets of positive plates were allowed to make three trips, or 18 miles. With one charge, however, if we have the least bit of snow, the batteries are scarcely able to make a trip of four miles, or from the car house to the I. C. R. R. depot and return, and in many instances they could not do that, and had to be towed to the car house. The original cost and maintenance of batteries since the latter part of May up to date amounts to $25,000.

The maintenance per cell is about $4 for every 60 days, if one runs the cars regularly as they ought to be run. These $4 include new positive plates, freight, pins, acid and labor and breakage. This makes the cost of maintenance $24 per cell per annum instead of $2.50, as per their guarantee, which would amount to $3,840 per car per annum.

However, making it only $4 for every 90 days would bring it up to $16 per cell per annum, or about $2,560 per annum for each car.

"The people of Dubuque, particularly those living near and above the car house, know what an intolerable nuisance the storage battery system is, as they have been daily run into the car house and have been obliged to wait while the batteries were being changed. And this happens almost every trip. One hears people daily saying that they would prefer to have the horses and mules back again rather than have the storage battery system continue, so disgusted are they with the way the latter has been running during the last four or five months.

"I do not pretend to say that all storage batteries are a failure, but ours most certainly are. There may be batteries having a much greater efficiency.

"I am sorry that we are compelled to install the overhead system on our road, for we should by all means prefer the storage battery system if it could be made a financial success."

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Chronological History of Electricity, Galvanism, Magnetism and the Telegraph, from B. C. 2637 to A. D. 1888.—Part I.

BY P. F. MOTTELAY.

For a very interesting account, see "A description of the great Meteor which was seen on the 6th March, 1715–1716, sent in a letter . . . to R. Danuye . . . ," London, 1723 (*Phil. Trans.* for 1720–1721, vol. XXXI.), by Roger Cotes (1682–1716), of whom Sir Isaac Newton entertained so high an opinion as to frequently remark: "If Mr. Cotes had lived, we had known something" ("Biographia Philosophica," pp. 512–516; English Encycl., "Biography," vol. II., p. 401). Other exceedingly interesting accounts of aërolites are to be found, more particularly in Frederic Petit's works, published at Toulouse, in the *Phil. Mag.*, vols. 17, 20, 28, 32, 36, 43, 46, 48, 50, 53, 54, 56–59, 62, and in Bigot de Marogne's Catalogue, published in London, 1814. While treating of this subject, it may be well to add here that up to the year 1887 diamonds were not known to exist in meteorites. In a very remarkable paper by Prof. A. E. Foote, read before the Geological section of the Am. Asso. Adv. Sci., at its meeting in Washington, he described having, during the month of June, 1891, explored Crater Mountain (Cañon Diablo), 185 miles north of Tucson, Ariz., where he found some extraordinary specimens. The extreme hardness of one of these attracted particular attention, and upon carefully examining it he discovered in some of the cavities many small black diamonds as well as a white diamond one-fiftieth of an inch in diameter. This is said to be the most extensive find of the kind yet made.

A. D. 1794.——Mr. J. Churchman publishes his improved "Magnetic Atlas or Variation Charts of the whole terraqueous globe, etc." which Sir John Leslie subsequently pronounced the most accurate and complete hitherto made. The charts preceding it worthy of note were those of Dr. Halley (see A. D. 1683), of Mountain and Dodson, in 1744 and in 1756, of Wilke, in 1772, and of Lambert, in 1779.

In his chart Churchman refers his variation lines to two poles, one of which he places, for the year 1800, in lat. 58 degrees N. and lon. 134 degrees W. of Greenwich, while the other pole is in lat. 58 degrees S. and lon. 165 degrees E. of Greenwich. He supposes the northern pole to revolve in 1,096 years and the southern one in 2,289 years. ("Ency. Brit.," 1857, vol. XIV., p. 49.)

See Churchman's letters to Cassini, Phila., 1788, and his "Explanation of the Magn. Atlas . . . ," 1790; Harris, "Rudim. Mag.," part III., p. 101.

A. D. 1794.——Mr. Reusser (or Reiser), of Geneva, addresses a letter to the "Magazin für das Nueste aus der Physik" of Johann Heinrich Voigt (vol. IX., part I., p. 183), describing the construction of a new "species of electric letter post" ("Schreiben an den herausgeber") in the following words: ". . . On an ordinary table is fixed, in an upright position, a square board, to which a glass plate is fastened. On this plate are glued little squares of tinfoil, cut after the fashion of luminous panes, and each standing for a letter of the alphabet. From one side of these little squares extend long wires, enclosed in glass tubes, which go underground to the place whither the despatches is to be transmitted. The distant ends are there connected to tin foil strips, similar . . . to the first, and, like them, each marked by a letter of the alphabet; the free ends of all the strips are connected to one return wire, which goes to the transmitting table. If, now, one touches the outer coating of a Leyden jar with the return wire, and connects the inner coating with the free end of that piece of tinfoil which corresponds to the letter required to be indicated, sparks will be produced, as well at the near as at the distant tinfoil, and the correspondent there watching will write down the letter. . . ."

Reusser also suggested calling the attention of the correspondent by firing an electrical pistol through the spark; to him, therefore, belongs the credit of having first suggested the use of a special call for the telegraph.

See Vail's "History," p. 121; Voigt's "Magazin . . ." vol. VII., part II., p. 57; Shaffner, "Manual," pp. 133, 134; Forster's "Bauzeitung," 1848, p. 238; Ed. Highton, p. 38; Sabine, p. 11; "Appleton's Encycl.," 1871, vol. XV., p. 335; Reiser, "Der El. Würfel," Gotha, 1791; *Comptes Rendus*, tome VII., for 1838, p. 80.

A. D. 1794.——Prof. Boeckmann improves upon Reusser's idea, and does away with the 36 plates and the 72 wires which the latter is believed to have employed, by using, as Dr. Schellen expresses it, "the sparks passing at the distant station, using only two wires, through which first one and then, after certain intervals, more sparks are combinedly grouped" in a way to indicate particular letters. Like Reusser, he makes use of the pistol as a call signal.

See Zetzsche, "Geschichte der Elektrischen Telegraphie," p. 32; Boeckmann, "Versuch über Telegraphie und Telegraphen," Carlsruhe, 1794, p. 17; "El. Magn. Teleg.," 1850, p. 46; Gren's *Journal der Physik*, vol. I., for 1790; "Neue Abhandl. der Bairischen Akad. Philos.," vol. III.

A. D. 1794.——Edgeworth (Richard Lovell), an able English mechanical philosopher, better known as the father and literary associate of Maria Edgeworth, introduces his *tellograph* (contraction of the word *telelograph*), "a machine describing words at a distance," which originated in a wager relative to the prompt transmission of racing news from Newmarket to London. It consists merely of four pointers, in the form of wedges or isosceles triangles, placed upon four portable vertical posts and the different positions of which are arranged to represent letters and numbers.

Mr. Edgeworth claimed to have made experiments, as early as 1767, with an ordinary windmill, the arms and sails of which were arranged in different positions to indicate the several letters of the alphabet.

See Edgeworth's Letter to Lord Charlemont on the Tellograph, also his "Essay on the Art of Conveying Secret and Swift Intelligence," Dublin, 1797, republished in vol. VI. of the *Trans. of the Royal Irish Academy;* "Appleton's Ency.," 1871, vol. XV., p. 334.

A. D. 1795.——Lord George Murray, of England, submits to the Admiralty his six shutter telegraph, an improvement upon Chappé's original plan. Each of the six octagonal shutters was made to turn inside of two frames at different angles upon its own axis, thus affording the means of giving 63 separate and distinct signals. By its agency, information was transmitted from London to Dover in seven minutes, and it answered nearly all the requirements of the Admiralty till the year 1816, when it was superseded by the semaphore of Rear Admiral Popham. This method was, however, useless during foggy weather, when relays of horses had to be employed for conveying the news.

See "English Encyclopædia," "Arts and Sciences," vol. VIII., p. 66; Tomlinson's "Telegraph;" Turnbull, *El. Mag. Tel.*, 1853, p. 18; "Penny Ency.," vol. XXIV., p. 147.

A. D. 1795.——Salva (Don Francisco), a distinguished Spanish physician, reads a memoir, before the Academy of Sciences of Barcelona, from which the following is extracted: ". . . With twenty-two letters, or even with eighteen, we can express with sufficient precision every word in the language, and, thus with forty-four wires from Mataro to Barcelona, twenty-two men there each to take hold of a pair of wires and twenty-two charged Leyden jars here, we could speak with Mataro, each man there representing a letter of the alphabet and giving notice when he felt the shock. . . . It is not necessary to keep twenty-two men at Matara nor twenty-two Leyden jars at Barcelona, if we fix the ends of each pair of the wires in such a way that one or two men may be able to discriminate the signals. In this way six or eight jars at each end would suffice for intercommunication, for, of course, Mataro can as easily speak with Barcelona as Barcelona with Mataro . . . or the wires can be rolled together in one strong cable . . . laid in subterranean tubes, which, for greater insulation, should be covered with one or two coats of resin."

He is said to have approved of the use of luminous panes as indicated by Reusser; to have also suggested, as early as Dec. 16, 1795, the idea of a *submarine telegraphic cable* carrying several conductors, and to have proposed, at the same period, the laying of one between Barcelona and Palma in the island of Majorca.

In 1798, Salvá constructed a single wire telegraphic line between Madrid and Aranjuez, a distance of 26 miles, through which the signals were transmitted in the shape of sparks from Leyden jars. This is the line which is credited to Mr. L. de Bétancourt, a French engineer, by Alexander Von Humboldt, in a note at page 14 of Gauss and Weber's *Resultate, etc.*, for the year 1837.

On the 14th of May, 1800, and on the 22d of February, 1804, Salvá communicated to the Academy of Sciences at Barcelona two papers on galvanism applied to electricity, wherein he shows that a cheaper motive power is produced by the electricity of a number of frogs, and proposes a telegraphic apparatus in conjunction with the Voltaic column which is illustrated and described at pages 224 and 225 of Fahie's "History of Telegraphy." From the latter the following is taken: "This illustrious Spanish physician (Salvá) was therefore the first person who attempted to apply electricity dynamically for the purpose of telegraphing. It is, says Saavedra, not without reason, I must confess, notwithstanding my cosmopolitan opinions on scientific questions, that the Catalans hold Salvá to be the inventor of electric telegraphy. With documents as authentic as those which I have seen with my own eyes in the very handwriting of this distinguished professor (which documents are at this present moment to be found in the library of the Academy of Sciences of Barcelona) it is impossible for any author to henceforth deny, even if others did precede Salvá in telegraphic experiments with static electricity, that no one preceded him in the application of the docile electrodynamic fluid to distant communications."

See *Comptes Rendus*, Séance 1838; Memorial of Joseph Henry, 1880, p. 224; Ed. Highton, *The El. Tel.*, 1852, pp. 38 and 43; "Appleton's Encyclopædia," 1871, vol. XV., p. 335; *De Bow's Review*, vol. XXV., p. 551; Voigt's *Magazin, etc.*, vol. XI., part 4, p. 61; *Sc. Am. Supp.*, No. 547, p. 8,735, and No. 384, p. 6,127; Biography in Saavedra's *Revista, etc.*, for 1876; Noad's *Manual*, pp. 747 and 748; Shaffner, *Manual*, p. 135; Turnbull, *El. Mag. Tel.*, 1853, pp. 21, 22, 220; Du Moncel, *Exposé*, vol. III.; "Edinburgh Encyclopædia," London, 1830, vol. VIII., p. 535; "Gazette de Madrid," of November 25, 1796; "Mémoires de l'Institut," vol. III., and "Bulletin de la Soc. Philom.," A. VI., for the new telegraph of MM. Bréguet and Bétancourt, and for the Report made thereon by MM. Lagrange, Laplace and others.

A. D. 1795.——Ewing (John) D. D., Provost of the University of Pennsylvania and one of the founders of the American Philosophical Society, makes a compilation of his course of lectures on natural experimental philosophy, which is subsequently revised for the press by Prof. Robert Patterson.

He devotes much attention to atmospheric electricity, detailing the Franklinian theory, and, besides remarking upon the hypothesis advanced by Henry Eales as well as treating of the attraction of magnetism, he gives a very interesting account of experiments with the torpedo and the gymnotus electricus. He says that Mr. Walsh found the torpedo "possessed of the power of shocking only in two parts of its body, directly opposite to each other and near to the head. A spot on the back and another on the belly opposite to the former being of a different color, led him to make the experiment, and he found that the electrical virtue was confined to these, and that any other part of the fish might be handled, without receiving a shock, while it was out of the water. Either of these places separately might be handled without the shock being received until a communication between them was formed. This makes it appear probable that the same may also be the case with the Guiana eel. One of these spots must therefore be always in the positive and the other in the negative state: or, rather, they are both generally in the natural state, until, by an effort of the fish's will, they are suddenly put into different states, as we frequently found that the hand might be in the water, which formed the communication, without receiving any shock. This cannot be the case with the Leyden bottle when charged, which suddenly discharges itself upon forming the communication. Whether there be any electric atmosphere round these spots in the torpedo we cannot tell, as we had no opportunity of examining this matter in the eel, nor have we heard whether Mr. Walsh made any experiments for ascertaining this matter."

A. D. 1795.——The telegraphs of the Rev. J. Gamble, Chaplain to the Duke of York, consisted either of five boards placed one above the other or of arms pivoted at the top of a post upon one axis and capable of producing as many signals as there are permutations in the number five, all the combinations being possible at equal angles of 45 degrees. His doubts as to the practicability of employing electricity "as the vehicle of information" are fully expressed at page 73 of his "Essay on the different modes of communicating by signal, etc.," London, 1797.

See J. Gamble, "Observations on telegraphic experiments, etc.;" Article "Telegraph" in Tomlinson's "Encyl. of useful arts;" "Penny Ency.," vol. XXIV., pp. 147 and 148; "English Ency.," "Arts and Sciences," vol. VIII., p. 66.

A. D. 1795.——Garnet (John), proposes a telegraph consisting of only a bar moving about the centre of a circle upon which latter the letters and figures are inscribed. By placing corresponding divisions, by means of wires, before the object glass of the telescope the coincidence of the two radii or of the arm would point out the letter intended to be repeated. This plan, however, proved impracticable for long distances and naturally did not come into general use.

See "Emporium of Arts and Sciences," Phila., 1812, vol. I., p. 293.

A. D. 1795.——Wells (Charles William), a physician, native of South Carolina but practicing in England and a F. R. S., publishes in the *Phil. Trans.*, a paper on the influence which incites the muscles of animals to contract in Galvani's experiments. Therein he is the first to demonstate that voltaic action is produced through charcoal combined with another substance of different conducting power, and this he does by causing noticeable convulsions in a frog through the combination of charcoal and zinc. (See "Ency. Met.," vol. IV., pp. 220, 221, for the experiments of both Dr. Wells and Dr. Fowler.)

Fahie states that Davy subsequently constructed a pile which consisted of a series of eight glasses containing well-burned charcoal and zinc, using a red sulphate of iron solution as the liquid conductor. It is said this series gave sensible shocks and rapidly decomposed water and that, compared with an equal and similar series of silver and zinc, its effects were much stronger. (See Priestley's discovery of the electrical conductibility of charcoal at A. D. 1767; and the description of Davy's charcoal battery in

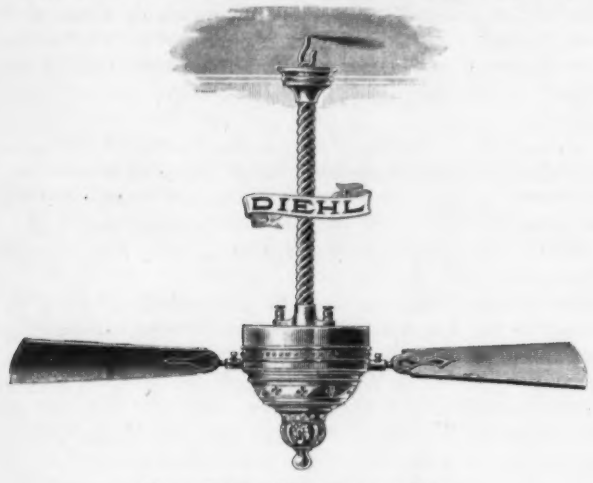
*Continued from THE ELECTRICAL WORLD of Jan. 30, 1892.

"Jour. Roy. Inst." and *Nicholson's Journal*, N. S. vol. 1, page 144.)

See also Well's biography in the "English Encyclopædia," vol. VI., p. 631; *Phil. Trans.*, for 1795, page 246; Fahie's History, etc., pp. 201 and 202; C. H. Wilkinson, "Elements of Galvanism, etc.," London, 1804, vol. I., pp. 162–165 and vol. II., page 329.

The Diehl Motor Fan.

The illustration shows a motor fan which during the approaching summer season and warm weather will be extensively used in the proper ventilating of stores, restaurants, etc. As will be seen from the cut, it is handsome and durable in design, requires no shafting or belting to mar the ceiling, and it is claimed is highly efficient from



The Diehl Motor and Fan.

an electrical and mechanical standpoint. Several points are claimed in its favor, among which are its freedom from the possibility of the motor heating, its perfect system of self-lubrication and the simplicity with which it is adjusted, requiring no attention whatever after such adjustment. It can be operated either on a direct incandescent or arc current.

Anyone visiting the salesrooms of Diehl & Co., 385 Broadway, will be shown many of the unique designs in both nickel and polished brass, and among other novelties in connection with the suspended fan which this firm will bring out the coming season is a device attached to the lower part of the bracket by which one will be enabled to start, run at a moderate or full speed, or stop the fan at will. Handsome designs in floor and counter column, bracket and propeller fans are also shown. The demand for these goods received last season necessitated an increase in the firm's manufacturing facilities. Such increase having been effected, they are prepared to fill all orders in a prompt and efficient manner, and judging from the large number of testimonials shown us from different points throughout the country the manufacturers should have a large and growing demand for their devices.

Chauncey Depew Says Electricity Will Soon Supercede Steam.

Dr. Chauncey Mitchell Depew, president of the New York Central Railroad, said, a few days ago, to a reporter of the *Herald*: "In a few years steam as a motive power will have given way to another far greater one. That will be electricity. It is certain to be, and it will be within a very few years, judging from what has been done by electricity during the past sixteen years. Why, just think of it! At the Exposition of 1876 there was absolutely no special department for the exhibition of the great wonders of electricity, simply because there were no great wonders. All there was to show was the mere telegraph instruments and wires, etc., that we were all familiar with. Yet at the Chicago Columbian Exposition there is to be one grand building for nothing else but electrical exhibits of varied kinds, and all developed since then. Why, during the past twenty-five years greater developments and discoveries of every kind have been made than were even dreamed of during the 2,500 years that preceded that period."

The Stiles Punching Press.

The illustration shown herewith represents a new design and the proportions of the No. 4 Stiles punching press,

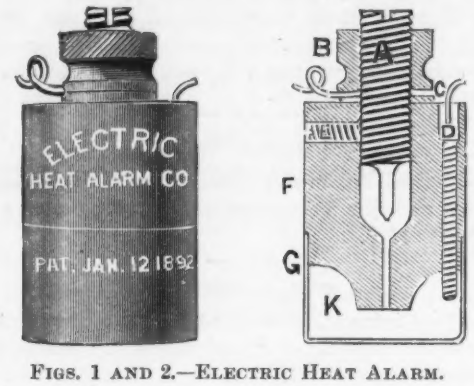
The Stiles Punching Press.

which is designed for use in manufacturing establishments where articles requiring heavy punching are manufactured. The range of work for which it is adapted, it is stated, covers nearly every kind of blank cutting, punching, perforating, forming and bending, including a large proportion of the operations needed in the manufacture of hardware, locks, cutlery, guns, sewing machines, typewriters and many other articles made out of sheet metal. Recently several improvements have been made in its construction and in the details—the guides have been lengthened and the frame strengthened. This press is made in seven sizes, ranging in weight from 500 to 12,000 lbs., and can be furnished as a flywheel or geared press. E. W. Bliss Co., Limited, of Brooklyn, N. Y., are the manufacturers.

An Electric Heat Alarm.

The illustrations show an electric heat alarm, which is designed for use in central stations for the purpose of giving notification of the heating of bearings, either on an engine, a line of shafting, or a dynamo or motor.

The device is shown in Fig. 1, which is half as large as the original, and Fig. 2, a section of the same. From Fig. 2 it will be seen that the lower half of the device is a Bessemer steel cup, $\frac{1}{32}$ inch thick and $\frac{1}{2}$ inch deep inside, into which is firmly pressed a piece of hard fibre B $\frac{3}{8}$ inch diameter, $\frac{7}{8}$ inch long, shaped as shown in the drawing, and having at the bottom $\frac{1}{16}$ inch clearance from the steel cup. The hole through the centre of the fibre is tapped at the upper end for the reception of the screw C, $\frac{7}{32}$ inch clearance, which is turned down at its lower end, the hole in



Figs. 1 and 2.—Electric Heat Alarm.

the fibre being also very much smaller at its lowest end—being bored with a No. 60 drill. This screw C is connected at its upper end by means of the nut to the wire leading from one pole of the battery. A is a reservoir, which is filled with mercury, which also enters the small hole in the fibre, the top of this hole being however $\frac{1}{16}$ inch higher than the top of the mercury chamber.

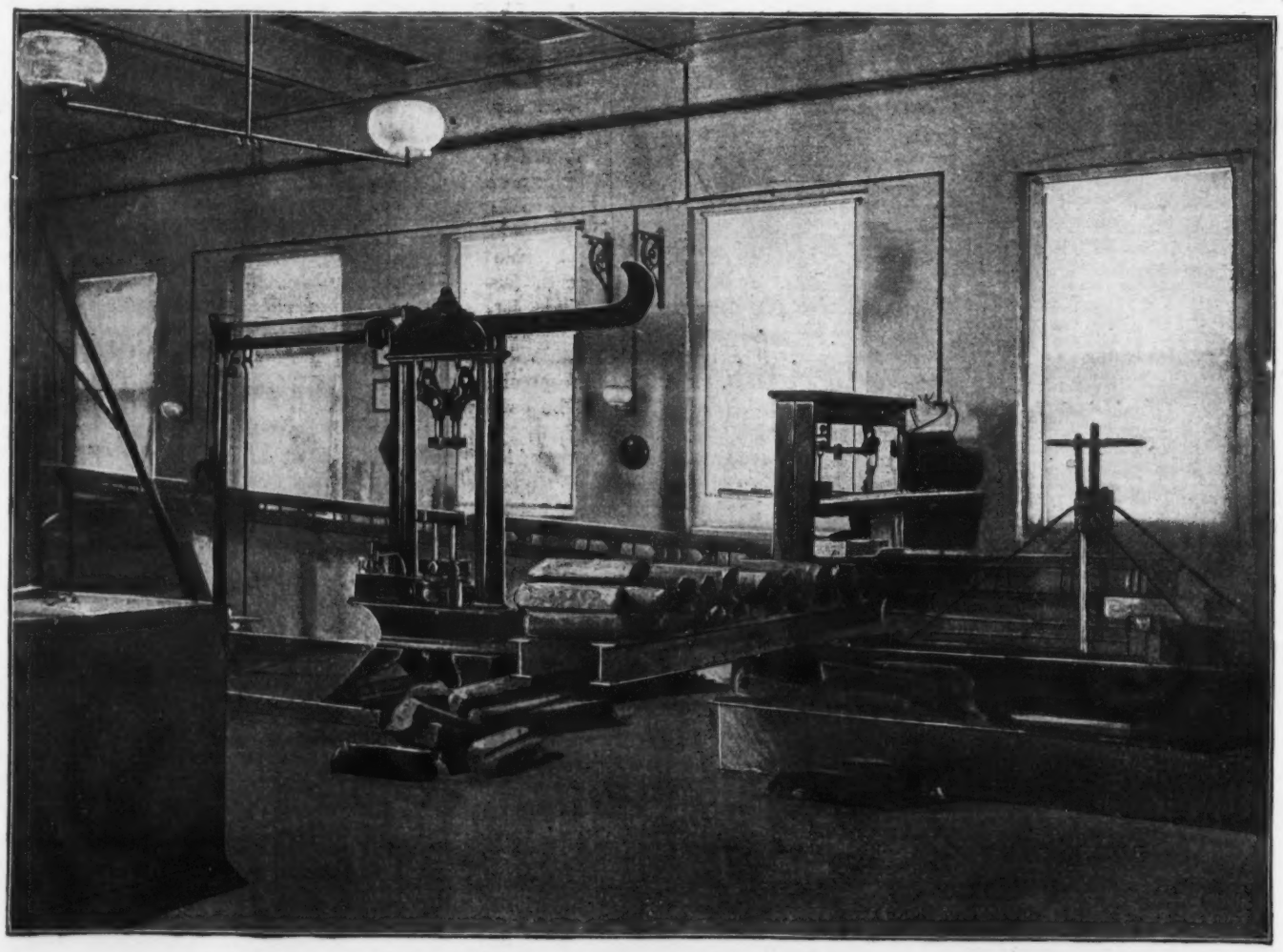
The amount of heat necessary to set off the alarm can be varied by moving the screw A up or down, and when its position for a certain temperature is fixed, it is firmly held in its place by a small set screw shown in Fig. 2. It is the joint invention of Messrs. Pierce, Desiles and Oliver, and is being placed upon the market by the Electric Heat Alarm Company, of 113 Devonshire street, Boston, Mass.

Test of Iron and Steel Poles for Street Railway Work.

Up to the present time very few accurate scientific tests have been made to determine the strength of iron and steel poles such as are ordinarly used in street railway work. The tests recently made in the Cornell University testing laboratory of the Milliken Bros. railway poles are for this reason of considerable interest. The tests were very elaborate in their nature, and covered quite a variety of designs of this company's poles.

The accompanying illustration shows a view of the testing room at the University while the first pole was under test in the huge testing machine which belongs to the laboratory equipment of that institution. The tests were conducted by Professor R. C. Carpenter under the direction of Dr. R. H. Thurston, the director of Sibley College. The object of the tests was to determine the behavior of the said poles when subjected to a pull at the end in a direction normal to the axis of the pole and of sufficient magnitude to cause permanent deformation or "set." The report of the tests as submitted shows that the same were conducted very thoroughly and cover the ground fully.

It also shows that the Milliken poles are of superior quality in regard to strength and well adapted for service of the kind ordinarily met in street railway construction. These poles are manufactured by Messrs. Milliken Bros., of New York, who will doubtless be pleased to send a full copy of Professor Carpenter's report to any one sufficiently interested in the subject to inquire for it. Interesting comparisons are made with the strength of pine poles when submitted to similar tests.



TESTING A MILLIKEN POLE IN THE CORNELL UNIVERSITY LABORATORY.

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, Jan. 30, 1892.

The stock market during the week has been a broad one, and in many particulars the most satisfactory market for some time. The investors have taken the place of the room traders, and have been large buyers of securities, and particularly of bonds. The current of events that materially influences values is now favorable to the holders of securities, and tends to inspire confidence in the prevailing market. The best evidences of firmness are recognized in a few stocks which are the natural leaders on the list. The principal railroad and electric stocks always show by their prices the real tendency of the market, and the fact that they are now being bought by investors and are finding their way to strong boxes is a just criterion by which to gauge the present strength and future prospects of the financial situation. Among the more active electrics Thomson-Houston stock has again reached its highest figure for many months, 52, and has been quite active around that price. Westinghouse Trust Company's receipts have been strong at about 13, but the sales have been few. The new stock made its appearance during the week on the market, and sales were made at 20. Increasing strength is noticed in Fort Wayne, and Series A issued by that company. The latter has steadily increased in value since it was issued in November.

Fort Wayne Stock.—"Rialto" in the Boston *Advertiser* recently stated the following in answer to an inquiry in regard to this company: "Fort Wayne Electric has earned the past year, and has paid to its stockholders, $1.50 per share, and a good surplus has also been created. It is to do, so I am informed, the bulk of the electric light business that the Thomson-Houston Company cannot attend to, that company owning the control of the stock, and being so crowded with work that the far Western business in lighting is getting beyond its facilities. They have increased facilities now, with an enlarged plant, and the property is much more valuable than when the stock sold at higher figures."

Edison General Electric.—An advance was made during the week in Edison General Electric, which was based on a belief that a favorable decision on the appeal from the decision declaring Edison the inventor of the incandescent lamp would be handed down at an early date by the Supreme Court. It is understood, however, that while the decision is expected to be favorable to the Edison company, the case is not at present being considered by the Supreme Court, on account of illness of the counsel for the company.

Bell Telephone is always more or less active and strong, for its large dividends are very attractive.

Money Seeking Investment.—The statements of the national banks of New York and Boston show larger reserve funds on hand than at any time since 1888. The banks are reducing their rates of interest to depositors, and good commercial paper finds a ready market at 3½ per cent. to 5 per cent, according to the length of time; however, there is not enough demand for all the money available. This extreme ease in money is an important factor in the favorable condition of the stock market, since the low rates and limited demand are causing numerous financial institutions and individual capitalists to enter the stock market for a more profitable use of their funds than is accessible in the loan market This being the condition of affairs, we find that investors thus seeking safe and dividend-paying stocks take kindly to the electrics. There are more buyers than sellers; and if the electric companies only had more stock, it could be circulated in as wide a market as are some of the railroad stocks.

Electric Bonds.—Every week shows great advancement made in the marketing of electric bonds. This fact is particularly noticeable, perhaps because they have for so long been so difficult to sell to advantage, and many a local company has been retarded in desired progress, and often even forced to the wall because of an inability to find a market for bonds on the property by which to make additions to increase facilities for meeting the demands, which always arise in an enterprising town. A case in point where a good thing has been recognized, and has not been allowed to fail for want of proper support, is the Olympia Light and Power Company, of Olympia, Wash. The company has issued $150,000 worth of six per cent. first mortgage bonds, on property which cost $.25,000, and from which the annual net income is $18,000. The property has been thoroughly examined by competent parties and its value is placed at even a higher figure than the actual expenditures show. Of this issue of bonds, $90,000 have been placed by private subscription, and the remaing $60,000 are offered by the American Loan and Trust Company, of Boston, at 92 and accrued interest. The fact that this trust company handles the bonds, of itself commends them to investors. It should not be very long before trust companies and banks will take to electric bonds as kindly as they have in the past to the securities of water, railroad and real estate companies. The business of the year 1891 of the Thomson-Houston Electric Company has exceeded that of all previous years. The factories have shipped a total tonnage of 39,170,025, against 32,258,434 in 1890. Average tonnage per day was 65, against 53½ in 1890, an increase of about one carload per day. During the past year the company has equipped 63 new electric roads in this country. The factory was shut down three days this week to take account of stock, as the fiscal year ended Jan. 30.

Dividends have been declared by the Somerville, Mass., Electric Light Company, semi-annual, 3 per cent.; the Peninsula Electric Light and Power Company, Houghton, Mich., stock dividend; the Thomson-Houston Electric Company, a dividend of $1 per share, payable Feb. 15; The Uxbridge, Mass., and Northbridge Electric Company, a semi-annual dividend of 2 per cent.; the Royal Electric Company, of Montreal, Canada, a quarterly dividend of 2 per cent., payable Feb. 15; the New England Telephone Company, a dividend of $1.25 per share for the quarter, payable Feb. 15; Edison Electric Illuminating Company, of New Orleans, La., quarterly dividend of 2 per cent.; the Great Western Electric Supply Company, Chicago, a dividend of 2 per cent., amounting to $7,000 on the $350,000 of preferred stock; the executive committee of the Erie Telegraph and Telephone Company, recommending a quarterly dividend of 1 per cent.

Increase in Capital Stock.—The following companies have increased their capital stock: The Peninsula Electric Light and Power Company, of Houghton, Mich., fron $75,000 to $100,000, and the number of shares from 7,500 to 10,000; the Chicago Telephone Company, of Chicago, Ill., has certified to an increase to $5,000,000; the Douglas County Street Railway Company, of Superior, Wis., amended articles increasing capital stock to $150,000; the Plymouth and Kingston Street Railway Company, of Plymouth, Mass., has petitioned to increase its capital stock from $35,000 to $100,000, so as to absorb its floating debt and to extend its branches.

Decrease in Capital Stock.—The North American Electric Company, of Chicago, from $1,000,000 to $100,000.

Closing Quotations.—The following were the closing quotations of electric stocks on Saturday, Jan. 30, 1891, in New York and Boston:

NEW YORK QUOTATIONS.

Name of Stock.	Par.	Capitalization.	Bid.	Ask'd.
Western Union Telegraph Co	100	86,200,000	84	85½
American Telegraph & Cable	100	14,000,000	....	82
Central and South American	100	5,000,000	....	....
Mexican	100	2,000,000	....	....
Commercial Cable Co	100	7,716,000	....	....
Postal Telegraph Cable	100	5,000,000	28	33
Edison General Electric	100	15,000,000	97	98
Consolidated Electric Light	100	2,500,000	20	30
Edison Illuminating Co., of New York	100	4,500,000	81	82
" " " Brooklyn	100	750,000	74	78
" " " Boston	100	1,263,500	97½	102½
" " " Chicago	100	750,000	135	145
U. S. Illuminating Co	100	1,250,000	30	35
North American Phonograph Co	....	....	4	6
New York Phonograph Co	100	6,200,000	2½	5
Edison Elec. Light Co. (of Europe) stock	100	2,000,000	2½	5
" " " " bonds	sh	30,000	65	75
" Ore Milling Co	100	2,000,000	17½	22½
" Toy Phonograph Mfg. Co	10	1,000,000	....	½
U. S. Electric Light Co	100	1,500,000	15	20
Brush Illuminating Co., of New York	50	1,000,000	40	50
Mt. Morris Electric Light Co	....	500,000	....	60
East River Electric Light Co	100	1,000,000	....	60

BOSTON QUOTATIONS.

	Par.	Capitalization.	Highest.	Lowest.	Bid.	Ask'd.
Thomson-Houston Elec	25	6,000,000	52	51	51¾	52
Thomson Houston Elec. preferred	25	4,000,000	27	26¼	27	27⅛
Thomson-Houston Elec.—Series C	sh	40,000	....	....	7⅞	8⅛
Thomson-Houston Elec.—Series D	sh	120,000	7¼	....	7¼	....
Thomson-Houston Int'n'al Elec	100	600,000	....	....	....	200
Thomson-Houston Int'n'al Elec—Pfd	100	400,000	....	....	101	103
Thomson Elec. Weld	100	1,000,000	55	....	....	55
Thomson European Elec. Weld	100	1,509,000	13	12½	12½	13
Westinghouse Elec	50	10,000,000	12¾	12¼	12¾	13
Fort Wayne Elec	25	4,000,000	13¾	12⅝	13	13⅜
Fort Wayne Elec.—Ser A.	sh	80,000	7¼	7	7⅛	7¼
Detroit Elec	10	1,000,000	8¾	8	8½	8¾
West End St. Ry. Co.—Com	50	7,150,000	....	....	72	72¼
West End St. Ry. Co.—Pfd	50	6,400,000	....	....	84½	84¾
American Bell Tel	100	15,000,000	210	207½	209	210
Erie Tel. & Tel. Co	..	.....	....	....	43½	44
Mexican Tel. Co	..	.....	....	....	115	125
New Eng. Tel. & Tel. Co.	..	.....	....	....	51	52
Tropical Tel. Co	..	.....	....	....	....	50c.

Chicago Quotations.—Col. S. G. Lynch, broker, 153 Monroe street, Chicago, furnishes quotations on electrical stocks as follows:

TELEPHONE STOCKS.

Chicago	$224@ $226	Cumberland	$60@ $62
Central Union	54@ 56	Wisconsin	118@ 120
Michigan	81@ 83	Bell of Missouri	175@ 180
Great Southern	30@ 32	Iowa Union	20@ 22
Colorado	34@ 36	Missouri & Kansas	50@ 53
Rocky Mountain Bell	40@ 43		

ELECTRICAL STOCKS.

Chicago Arc Light and Power	$84@ $86	Chicago Edison Co	$140@$142

NEW INCORPORATIONS.

The Deposit Electric Company, of Deposit, N. Y., capital stock $12,000, has been formed to manufacture and use electricity for light, heat and power. C. M. Putman, C. H. Putman and Chas. Knapp are the incorporators.

The Pen Argyl Electric Light and Power Company, of Pen Argyl, Pa., capital stock $10,000, has been formed to supply light, heat and power by means of electricity. Jno. S. Jackson, C. G. Fitzgerald and Henry E. Stephens are the incorporators.

The Connellsville Electric Railway Company, of Connellsville, Pa., capital stock $ 00,000, has been formed to operate a street railway in Connellsville, Pa. H. C. Houston, Worth Kilpatrick and John L. Gans, all of Connellsville, are the incorporators.

The Apollo Electric Light, Heat and Power Company, of Apollo, Pa., has been formed with a capital stock of $20,000, to supply light, heat and power by means of electricity. Geo. G. McMurtry, Wallace P. Bache and Jas. S. Whitworth are the incorporators.

The Somerset Electric Light, Heat and Power Company, of Somerset, Pa., has been formed with a capital stock of $12,000, to supply electricity in the borough of Somerset, Pa. G. B. Hough, A. W. Knepper and J. A. Berkey, all of Somerset, are the incorporators.

The Consolidated Brush and Novelty Company, of Paterson, N. J., capital stock $50,000, has been formed to manufacture composition and other materials for electrical and novelty goods. C. A. Bishop, A. L. Schwarz and A. V. Bishop, of Paterson, N. J., are the incorporators.

The Home Lighting and Fuel Company, of Parkersburg, W. Va., capital stock $250,000, has been formed to manufacture and distribute gas and electricity. B. D. Spillman, J. A. Wetherelle and J. L. Buckley, all of Parkersburg, W. Va., are the incorporators.

The Hancock Light and Power Company, of Findlay, O., capital stock $25,000, has been formed to generate electricity and furnish same for light, heat and power. Chas. F. Smith, Jas. A. Bopo, Wm. C. Neibling, Vincent H. Coons and Linden R. Clark are the incorporators.

The Meyrowitz Manufacturing Company, of Ridgefield, N. J., capital stock $100,000, has been formed to manufacture optical goods, surgical and electrical instruments. S. B. Meyrowitz, Ridgefield, N. J.; P. A. Meyrowitz, and C. W. Meyrowitz, New York, N. Y, are the incorporators.

The Mosher Arc Lamp and Manufacturing Company, of Chicago, Ill., capital stock $25,000, has been formed to manufacture electric arc lamps, switches, cut outs and other electric appliances pertaining to electric lighting. J. M Fisher, J. A. Mosher add G. W. Carpenter are the incorporators.

The Electrical Conduit Company, of Long Branch, N. J., capital stock $300,000, has been formed to purchase and acquire certain patent rights on improvements in underground electrical conduits and conductors, etc. L. May, C. A. Henriques, A. Wolff, Jr., J. Thomas and C. P. Barker are the incorporators.

The Universal Power Company, of New York, N. Y., capital stock $15,000, has been formed to produce and supply power by utilizing the forces of nature and transmission of such power by electrical and mechanical combination. John S. Bell, Wm. A. Nicholson and N. H. Tatler are the incorporators.

Clinton County Electric Light, Heat and Power Company, of Lock Haven, Pa., capital stock $25,000, has been formed to supply light, heat and power to the city of Lock Haven, and to persons, partnerships and corporations, etc. Chas. M. Blanchard, Chas. M. O'Connor and E. B. Shoemaker are the incorporators.

The Everett Terminal Company, of Everett, Wash., capital stock $500,000, has been formed to operate railroads, telephone and telegraph lines, electric light plants, gas and water works, docks, wharves, warehouses, depots, bridges and ferries. Wyatt J. Rucker and Bethel J. Rucker, of Tacoma, Wash., are the incorporators.

The South Florida Electric Company, of Bartow, Fla., capital stock $2,500, has been formed to build, construct, equip, and operate within the State of Florida telephone lines, call bells, fire alarms, electric light plants and electrical apparatus and machinery. C. J. Seegar, F. J. Maywald and W. E. Prince are the incorporators.

The Massillon Light, Heat and Power Company, of Massillon, O., capital stock, $15,000, has been formed, to manufacture and furnish light, heat and power by means of electricity, gas, steam or compressed air. J. Walter McClymonds, Jos. K. Russell, Geo. L. Russell, Warren E. Russell, Allen A. Russell and C. M. Russell are the incorporators.

The Electric Reciprocating Company, of Denver, Colo. capital stock $250,000, has been formed to manufacture, buy and sell all classes and kinds of electrical appliances as well as to acquire and dispose of patent rights for the same. Asanel J. Severance, Chas. W. Buck, H. William Kirchner, Wm. P. Carstarphon, Jr., and Chas. E. Snyder are the incorporators.

The Palomar Mountain Water Company, with its principal office in New York City, capital stock $5,000,000, has been formed for the storing and distributing of water for the irrigation of land in the county of San Diego, Cal., also to supply cities and towns with water, and for constructing and operating electric railroads. F. D. Rounds, E. W. Dewt, of New York, and T. E. Bond of Oceanside, Cal., are the incorporators.

The Creede-Amethyst Electric Power and Water Company, of Denver, Colo., capital stock $100,000, has been formed to construct and operate by electricity or other power a railroad and telegraph line from Jimtown to Creede or Amethyst, Colo., and from said towns to the mines. David G. Peabody, Richard T. Root and Robert M. Kennedy, of Denver, Colo., and Ernest G. Miller, of Creede, Colo., are the incorporators.

AFFAIRS OF THE COMPANIES.

The Roberts-Brevoort Electric Company, Limited, of New York, will hold its annual meeting Feb. 10.

The South Side Electric Railway Company, of Kansas City, Mo., at its annual meeting re-elected its old board of directors.

The Chester (Pa.) Electric Light and Power Company has elected the following officers: T. G. Sweeney, vice-president; S. H. Seeds, treasurer; T. S. Hall, secretary; G. P. Denis, manager.

The Latrobe & Derry (Pa.) Electric Street Railway Company has elected officers as follows: J. W. Hughes, president; J. B. Miller, J. E. Heck, C. O. Slater, and D. J. Bush, directors.

The Washington & Tenalleytown Railroad Company, of Washington, D. C., has submitted to the Senate its annual report as follows: Receipts, $107,962.78; disbursements, $107,909.70; number of passengers carried, 798,637.

The Rochester (N. Y.) Railway Company, at its annual meeting elected the following officers: President, John N. Beckley; vice-president, Benjamin Graham; secretary, Charles A. Williams; treasurer, Frederick P. Allen.

The East River Electric Light Company, of New York, by Wm. H. Keely, counsel for the company, has applied to the Supreme Court for permission to change its title to the Thomson-Houston Electric Company of New York.

The Consolidated Electric Company, Limited, is a new company recently formed at St. John, N. B., by the consolidation of the Eastern Electric Company, the St. John Street Railway Company and the New Brunswick Electric Company.

The Burlington Electric Street Railway Company, of Burlington, Ia., has acquired, it is stated, the franchise and equipment of the Burlington Electric Light and Power Company, through a transfer of $10,000 in bonds, which were held by C. H. Rand.

The Braddock & Turtle Creek Street Railway Company, of Braddock, Pa., at its annual meeting elected officers as follows: President, W. Yost; vice president, J. Renard; secretary, F. W. Edwards; treasurer and superintendent, G. L. E. Stamates.

The Eau Claire Street Railway, Light & Power Company, of Eau Claire, Wis., at its annual meeting elected officers as follows: President, Weston Lewis, Gardiner, Me.; secretary, L. N. Claussen, Washburn, Wis.; treasurer, W. G. Maxcy, Oshkosh, Wis.

The New Britain Electric Light Company, of New Britain, Conn., has elected officers as follows: John M. Spring, president; C. L. Whitney, secretary; R. J. Vance, treasurer. Directors, J. M. Spring, R. J. Vance, C. O. Case, T. McCabe, J. Hanna, P. Corbins, W. Wilcox.

The Eckington & Soldiers' Home Railroad Company, of Washington, D. C., has made its annual report to Congress as follows: During the year the company carried 1,076,744 passengers, 870,723 paying full fare and 206,021 traveling on transfers. Total receipts were $180,310.68; total disbursements, $179,744.40.

The Edison Electric Illuminating Company, of New York, has elected the following directors: A. A. H. Boissevain, R. R. Bowker, C. H. Coster, Charles E. Crowell, Thomas A. Edison, J. Buchanan Henry, E. H. Johnson, D. O. Mills, George Foster Peabody, F. S. Smithers, Spencer Trask, Henry Villard and J. Hood Wright.

The Lynn (Mass.) Gas and Electric Company has elected the following directors: J. G. B. Adams, F. D. Allen, C. H. Baker, J. S. Bartlett, A. F. Breed, M. P. Clough, G. B. Neal, C. H Newhall, Lucian Newhall, A. W. Tufts and C. F. Prichard. The following officers have been elected: C. H. Newhall, president, and C. C. Fry clerk and treasurer.

The Kansas City Electrical Works at its annual meeting re-elected the old board of directors. The directors elected the following officers: W. H. Woodring, president; A. R. Lyon, secretary, and D. A. Williams, treasurer. A. J. Burns, formerly with the Edison General Electric Company, was retained as superintendent of construction and repairs.

The Sandy Hill Electric Light and Power Company, of Sandy Hill, N. Y., has elected the following officers: Directors, J. H. Derby, M. C. Allen, S. H. Kenyon, W. B. Baldwin, J. J. Cunningham, C. T. Beach, and J. E. Howland. The officers elected were as follows: President, J. H. Derby; vice president, S. H. Kenyon; secretary, G. M. Ingulsbee; treasurer, C. T. Beach; manager, S. H. Kenyon.

The Portland Street Railway Company, of Portland, Me. at its annual meeting elected Wm. R. Wood president, and E. A. Newman treasurer and general manager. The report of the year's business was submitted and showed total earnings, $149,399.13; operating expenses, $127,880; net earnings, $18,697.74; surplus, $3,295.96. The road is operating suburban lines by electricity, and contemplates extensions of its electrical lines to Westbrook and Deering.

The Cleveland Telephone Company, the Northwestern Telephone Exchange Company and the Southwestern Telegraph

and Telephone Company report for the three months ending Dec. 31, 1891, is as follows: Gross income, $222,484; gross expenses, including dividends paid, $213,860; surplus, $8,625; proportions of dividends received by the Erie Telegraph and Telephone Company, $54,995; dividend No. 33, $48,000; surplus, $6,995. Total surplus for the three months, $15,620.15.

The Reading Electric Light and Power Company, of Reading, Pa., at its annual meeting elected directors and officers as follows: Directors, Jerome L. Boyer, Jesse Orr, Levi Quier, O. W. Stager, James Nolan, John G. Mohn and Henry W. Darling, of New York. Officers, Jerome L. Boyer, president, and J. K. Righter, secretary and treasurer. The following committees were also appointed: Executive, Messrs. Boyer, Orr and Quier; accounts, Messrs. Stager, Nolan and Mohn.

The Waverly (N. J.) Electric Light and Power Company at its annual meeting elected officers and directors as follows: Directors—Percy L. Lang, F. E. Lyford, Hugh J. Baldwin, Waverly, N. Y.; Geo. Koch, J. Geo. Kaelber, Rochester, N. Y.; C P. Henn, Buffalo; C. A. Brown, Chicago. Officers—President, Percy L. Lang; vice-president, Geo. Koch; treasurer, F. E. Lyford; secretary and superintendent, J. M. Lyford. Executive committee—Percy L. Lang, J. Geo. Kaelber, H. J. Baldwin.

The Edison Electric Light Company, of Philadelphia, held its annual meeting recently. The report of the Board of Directors shows the receipts during the year to have been $291,937.13, and expenses $194,008.07, and a net profit for the year of $79,958.07. The following were elected as the Board of Directors: Samuel B. Huey, John Lucas, Amos R. Little, H. Blake Tyler, Charles M. Swain, Daniel S. Lindsey, Arthur Colburn, William T. Tiers, L. D. Brown, William D. Markes and Joseph P. Ord, of New York.

The Utica (N. Y.) & Mohawk Railroad Company has submitted its annual report to the stockholders. This road was first opened for electric traffic on June 24, 1890. The report shows an increase of 47½ per cent. on the earnings, which to Dec. 31, 1891, for the year were $24,667.51. President Mann in his report recommended an increase in capital stock of $25,000 additional in order to make extensions. In concluding his report the president states that the road is now in a very prosperous condition and the outlook for the future is most promising. It is believed it can easily earn six per cent. on all the stock it is proposed to issue, and in a little time it is expected the earnings will be much larger.

The Standard Underground Cable Company, of Pittsburgh, Pa., held its annual meeting recently. A dividend of 1½ per cent. was declared on the capital stock of the company, payable on Feb. 10, the transfer books to be closed from Feb. 5 to 10 inclusive. At the stockholders' annual meeting there was a large representation present and the annual report of the vice-president and general manager, Mr. J. W. Marsh, on behalf of the board of directors, was followed with great interest. The business of the company for the year 1891 was very gratifying, having amounted to $518,677.27. The net earnings over all the expenses for the year were $65,858.37, and the total surplus earnings or undivided profits of the company up to Dec. 31, 1891, now amount to $369,213.50. During the year 1891 the company reduced its accommodation paper from $52,200 to $10,590, and in addition to this paid up all bills in full to Dec. 1, besides having discounted a portion of its December bills. An interesting disclosure made by the annual report is that the interest and discount account on the books of the company shows a credit balance for the year 1891. The company had 42 customers during the year 1891 whose purchases amounted to over $2,00 each, the entire purchases of the 42 aggregating $432,733,81; the total number of customers for the year was 305. The company does an extensive business in this country and abroad. The largest electric light cable contract taken during the year (which was also the largest single order ever placed in the United States for this class of goods) was that of the Minnesota Brush Electric Company, of Minneapolis, amounting to over 425,000 feet of cable, the contract including the complete installation of the cables ready for connections to houses, stores, offices, street lamps, etc., and to convey currents at 500 volts potential for power purposes, 1,000 volts for alternating incandescent lighting, and 3,500 volts for municipal and commercial arc lighting. Among other prominent customers were the Western Union and Postal Telegraph companies and the Gold and Stock Telegraph Company, the most prominent telephone companies in the United States and prominent railroad companies. The capacity of the company's factory is equal to turning out $1,000,000 to $1,250,000 worth of product per annum, if run night and day, while with day turn alone a capacity of from $600,000 to $750,000 worth is assured. The machinery of the company is of the most modern style, and is made almost exclusively from designs and patterns made at the company's works, and under patents owned by the company. The prospects are regarded as exceedingly favorable for a greatly increased business in the year 1892, the contracts already estimated on since the 1st of January being about three times as large in the aggregate as they were a year ago; this fact, together with the favorable result of last year's business, leads the directors to express their entire confidence in the future of the company. The old board of directors of the company were re-elected as follows: George Westinghouse, Jr. Mark W. Watson, John H. Dalzell, James H. Willock, John B. Jackson, George B. Hill, John Moorhead, Jr.; Robert Pitcairn and Joseph W. Marsh; and the following officers: Mr. Joseph W. Marsh, re-elected as vice-president and general manager; Mr. Frank A. Rinehart, secretary and treasurer, and Mr. O. R. Ebel, auditor, and John H. Dalzell, Mark W. Watson and James H. Willock were chosen as the executive committee for the ensuing year.

Special Correspondence.

NEW YORK NOTES.

Office of The Electrical World,
167-177 Times Building, New York, Feb. 1, 1892.

Alexander, Barney & Chapin report business as generally satisfactory in the several lines of electrical supplies which they handle.

Mr. H. Ward Leonard, of H. Ward Leonard & Co., states that business is very encouraging and that there is a steady demand for his controlling device for electric motors.

New York City Electric Lighting.—The Gas Commission has awarded contracts for public lighting to the Brush Electric Lighting Company and United States company. The bid of the East River company was laid over.

Mr. C. H. W. Copeland has opened a New York office in the Electrical Exchange building for the John T. Noye Manufacturing Company, of Buffalo, N. Y., and has taken the agency for the Rice automatic steam engine, manufactured by this company.

Mr. Chas. R. Huntley, president of the National Electric Light Association, was in the city Friday and Saturday on business connected with the forthcoming convention of the National Electric Light Association. He states that reports are very encouraging for a very large representation at the convention.

Mr. W. J. Hammer, the well known electrical engineer, sailed for Europe on the Etruria Saturday. He will be abroad several months and during the time will execute several important commissions for clients and will install at least one electrical exhibit at the Crystal Palace Electrical Exhibition.

The next lecture before the New York Electric Club will be on the anniversary of Lincoln's birthday, Friday evening, Feb. 12, and will be given by Mr. A. B. Chandler, president of the Postal Telegraph Company, on the very appropriate subject of "Reminiscences of Lincoln." The entertainment will also consist of war songs rendered by the Brunswick Quartet.

Mr. Levi J. Wing, president of the L. J. Wing Company, manufacturers of ventilators and dealers in electrical motors at 126 Liberty street, has been appointed receiver of the company on application of the directors. Stated liabilities, about $21,000; assets, $18,000. Mr. Wing claims that the liabilities are only $24,596.75, and assets $28,785, including doubtful accounts, etc.

Mr. H. S. Kaliske, manager lamp department, and Mr. W. E. Nickerson, electrician of the Beacon Vacuum Pump and Electrical Company, of Boston, were callers at our office during the past week. This company, it will be remembered, exhausts lamps by means of the Beacon metallic pump, and with only one pump is enabled to turn out 3,000 lamps per day. They report business as booming.

Mr. Edwin S. Riggs, assistant treasurer and a director of The E. S. Greeley & Co., died at his home in Brooklyn last week. The many friends of Mr. Riggs will hear of his death with regret. He had been associated with the above company for the past 12 years in the capacity of manager and purchasing agent of the railroad department. The funeral services were held Friday at 10:30 A. M. The remains were taken to New Haven, Conn., his former home, Saturday for interment.

The New York Electric Club at its last meeting listened to a paper read by Mr. T. C. Martin, describing the very interesting system of tabulating by electrical means the returns of the Eleventh Census. The inventor of the system, Mr. Hollerith, was present, and exhibited a very interesting set of the apparatus used in the census department at Washington at the present time. It is to be regretted that a larger number could not have been in attendance to examine the ingenious apparatus of Dr. Hollerith.

The Hunt Engineering Company, of 126 Liberty street, has been reorganized. Mr. George W. Hunt retains the presidency, and Mr. Albert E. Rich continues secretary and general manager. Mr. J. M. Bowen, of Brooklyn, well known in business circles as an energetic, successful financier and capitalist, has purchased the balance of the treasury stock of the company, has been elected treasurer, and will have control and management of the finances. Mr. H. C. Willis, formerly of the firm of T. F. Hunter & Co., of 33 Church street, well known to all connected in the electrical supply business as an energetic and pushing salesman, will have charge of the supply department. New quarters have been leased for the manufacturing of their many electrical devices, which are meeting with a ready sale, and we bespeak for them a successful year's business.

Dinner of the Magnetic Club.—The fourth annual dinner of the Magnetic Club was held at Morello's on Twenty-ninth street, in this city, on Wednesday evening of last week. President Cockey presided at the banquet table, around which were seated about 70 members of the club and a few invited guests, among whom were John W. Goff, ex-assistant district attorney; Mr. E. A. Leslie, general manager Manhattan Electric Light Company; and Mr. John R. Van Wormer, secretary of the Lincoln Safe Deposit Company. The announcement was made that at the recent annual election the officers chosen were as follows: E. C. Cockey, president; Thomas Brennan, W. H. Baker and F. W. Jones, vice-presidents; W. C. Burton, treasurer; G. F. Fagan, secretary. After dinner speeches were made by some of the invited guests, and the members were also entertained by an excellent programme, including vocal and instrumental music, recitations, and the usual, but always enjoyable, witticisms of Judge Green.

National Electric Light Association.—Mr. C. O. Baker, Jr., general master of transportation of the National Electric Light Association, has sent out the following letter: "I have received official notification from the Trunk Line Association, Central Traffic Association, and Southern Passenger Association, stating that they have granted, from points in their territory, a fare and a third rate to Buffalo, on the certificate plan, to cover the time of our convention." The fare from New York on the New York Central will be $12.34; on the West Shore, $11.33; Erie, $11.33; D. L. & W., $11.33. Mr. George F. Porter, secretary of the association, advises us that in compliance with the wishes of a majority of the members in regard to holding an exhibition in connection with the Buffalo meeting, it has been decided that no exhibit will be held under the auspices of the association. This, however, will not interfere with any arrangements which individual members may wish to make for having a display of goods at the hotel, as has been the custom heretofore.

For Police Electric Signals.—The Police Commissioners have given a hearing to the representatives of several companies wishing to compete for the contracts to furnish an electrical signal system for the Police Department. President Voorhis allowed each company ten minutes in which to make statements about their electrical systems and stated that they might send to the Commissioners any written description, plans or models which they desired to exhibit in competition. The merits of different companies were advanced by A. H. Chapman, general manager of the Municipal Signal Company, of Boston; Albert Watts, representing the Metropolitan Duplex Fire and Police Signal System, controlled by a Boston company; L. N. Downs, manager of the Metropolitan Electric Signal Company, of this city; F. B. Herzog, representing the Teleseme Company; Mr. Pearce, of the firm of Pearce & Jones; the Gamewell Fire Alarm and Police Signal Company, of New York; National Electric Manufacturing Company; the United Fire Alarm and Police Signal Company; the Porter Teletype Company and the Non-Interference Signal Company. The Commissioners decided to allow to the companies thirty days' time in which to present written specifications.

L. H. H.

Albany, Jan. 30, 1892.

The capacity of the electric light plant on River street, Troy, is increased by the addition of a 500-h. p engine.

A telegraph office has been opened at Schuyler, four miles east of Utica, where a branch runs from the Central to the West Shore Railroad.

The Johnstown & Gloversville Street Railroad Company will issue bonds to the amount of $70,000 if the lines are equipped electrically.

An Electric Light Commission appointed by the president of the village is a scheme that is looked upon with much favor by the people of West Troy.

Williamstown, N. Y.—There is considerable agitation over the inadequate lighting of the streets. It is very likely that it will result in an electric light plant taking its power from the Hoosick River.

The new electric light company that has the street light ing contract at Little Falls will turn on the arc lights on the even ing of Feb. 1. The village board will entertain the Amsterdam aldermen on that occasion.

The projectors of the proposed electric road between Gloversville and Fonda are not idle. The directors will at once take measures toward progressing the matter. They have all the capital necessary to build the road.

New Electric Line.—A gentleman who has taken stock in the proposed electric railway between Amsterdam and Gloversville recently said: "Every dollar's worth of stock has been taken and the road will surely be built. Work will begin when spring opens the way."

Change of Motive Power.—The question of converting the Johnstown, Gloversville & Kingsbow Home Railroad into an electric road is being freely discussed. Thomas W. Feary, of the Thomson-Houston Electric Company, has been in consultation with the officers of the road.

The Troy City Railroad Company, it is stated on good authority, will hold a meeting of the directors soon, and that Charles Cleminshaw will resign the presidency and James O'Neil will be elected his successor. Mr. Cleminshaw decided upon this step some time ago on account of exacting duties through his connection with the Troy and Lansingburgh Railroad companies and other corporations.

Among the bills introduced in the Legislature the past week, were the following: Regulating telephone charges at $85 per year in cities over 100,000 inhabitants, and $60 in cities of less.—Assemblyman Rice. Amending the military code, by providing for a signal and telegraph corps.—Assemblymen Farquhar. Amending the act incorporating the Lebanon Springs & Albany Turnpike Company relative to rates of fares.—Assemblyman Cassin.

The Albany Railway has recently added ten handsome new cars equipped with two 10-h. p. single reduction motors and with the latest improved Taylor trucks. The Steuben street line of the Albany railway, running from the Union Depot and joining the Washington avenue line at the Capitol park, has been formally opened. It was very satisfactory, and with one or two slight alterations in the overhead construction the line may now be said to be complete.

The Union Electric Railway, of Saratoga Springs, is an enterprise that has the attention of Albany capitalists. It is proposed to extend the line at the village end to the corner of the Grand Union Hotel, on Broadway. The feature of the road, however, will be the line, which, beginning at the Grand Union Hotel, will be constructed to the Saratoga race track, into which the company has secured the right to enter; and also to Saratoga Lake. Pullman double decked cars have also been contracted for. The cost of the old road was about $70,000. Nearly $200,000 will be expended on the new road. The bonded indebtedness will be $100,000 at 6 per cent. interest. The capital stock will be $300,000. The officers are: Charles E. Arnold, president; Edward J. Slattery, treasurer; Myer Nussbaum, secretary. The following are members of the executive committee, with the officers: Henry L. Smith and Clifford Gregory.

R. V. T.

PHILADELPHIA NOTES.

Branch Office of The Electrical World,
927 Chestnut Street, Philadelphia, Jan. 30, 1892.

Jas. W. Queen & Co. are doing an extensive business in their special line.

Priestman & Co. are now in a position to take orders for their small makes of oil engines.

W. H. Weston reports the sale of his special make of switches in excess of any week for the past month.

Vallee Bros. & Co. report their business in various lines as very good. They will in future be headquarters for the Warrell fuse block.

The Globe Electric Cordage Company, manufacturers of incandescent lamp cord, is making a specialty of flame and moisture proof cord.

The Chester Steel Castings Company makes steel castings for all electrical work from ¼ to 15,000 pounds weight. Its works are at Chester, Pa.

Pepper & Register, electrical engineers, will continue their business at the office recently occupied by the late firm of Clay, Pepper & Register.

The Cleverly Electrical Works is doing as much as the capacity of its works will allow. Its business is entirely in the line of electrical specialties.

The Camden Thread Company proposes extending its works, and when completed the company will own one of the largest glazed thread plants in the State.

The Imperial Electrical Company reports business in all its branches as very much improved. They will in future be pleased to give prices on automatic arc lamp pulleys.

O. D. Pierce & Co., dealers in electrical supplies and agents for the Perkins lamp, are simply rolling in the orders for this popular lamp. Their lamp display at their office is very neat.

The Philadelphia Traction Company is soliciting bids from various electrical companies for electrical equipment. All the different systems will be examined and estimates secured.

J. W. Parker & Co. have sold to the electric light companies of Leesburg, Va., a tandem Ball engine. This firm since Jan. 1, 1892, has been doing a rushing business.

The Star Electrix Company is meeting with much success with its invisible switch. This is something new for the trade to investigate. Mr. Spruance will be pleased to answer all inquiries.

Mr. C. A. Bragg, representative of the Westinghouse interest, reports a growing demand for Westinghouse apparatus. His sales for the last week were, if anything, slightly in advance of previous orders.

The Howard Foundry & Machine Company, manufacturers of street railway sweepers and elevators for car houses, has finished the construction of a large elevator for the Philadelphia Traction Company.

The LaRoche Electrical Works will in a short time commence the erection of a large factory to supply its growing demands, and proposes to enter extensively into the manufacture of motors and other specialties.

President Widener, of the Traction Company, was so much impressed with the practicability of the electrical system in use in Buda-Pesth, which he inspected last summer, that he secured control of the American patent, it is stated.

Messrs. J. W. Parker & Co., representatives of the Ball Engine Company, are setting up a 200-h. p. Ball engine at the Columbia Electric Light Company station. A number of new improvements are embodied in this engine, it is stated.

The Heisler Electric Company, among recent sales, has installed a 200 32-c. p. machine at Nevada City, Colo. The company now has its machines working in a large number of cities in the United States, besides having quite a foreign business.

Electric Road in Frankford.—The Board of Highway Supervisors has directed that a permit be issued allowing the Holmesburg, Tacony & Frankford Electric Railroad to lay its tracks in Colony street, from Tacony to Bristol turnpike.

Mr. Otis K. Stuart reports many inquiries concerning the new Germania dynamo which he is handling in this territory, although sales are not as active as they might be. But business seems to be picking up, and he believes that there will be a large amount of construction done this spring.

The Pennsylvania Electrical Engineering Company has moved to more commodious quarters in the Penn Mutual Building and in the midst of every variety of electrical supplies the Pennsylvania lamp blazes in all its glory. This young company is acquiring a splendid trade.

The Girard avenue street railway line may be equipped with the trolley system, poles for the wires being set in the middle of the street, and also carrying electric lights. Such a system would be least objectionable on Girard avenue, it is claimed, on account of its width, and that a model trolley electric line could be placed there.

The Price Railway Appliance Company has opened an office at 125 S. 5th street, and has on exhibition samples of its manufactures. Mr. Price is in daily attendance and those whose business may lead them to call may rest assured that it will be a pleasure to meet this genial gentleman, outside of the many advantages that may be offered from a business point of view.

The deal between the Traction Company and the People's Passenger Railway Company has been ratified, by which the former gets control of the lines of the latter by paying $40,000. It is regarded that the deal will be a good one for People's stockholders, as the Traction guarantees a dividend on each share of stock of $2.50 for the first year, $2.75 for the second, $3 for the third and $3.50 for the fourth, succeeding the deal.

To Be Heard in the U. S. Court.—The city recently brought suit against the Western Union Telegraph Company to recover $19,215.15, and against the Atlantic & Pacific Telegraph Company to recover $3,715 for fees for the erection of telegraph poles and the stringing of wires in the city. On application of the telegraph companies, these cases were certified to the United States Circuit Court for trial, the parties defendant being foreign corporations, and as such entitled to have their cases heard in the United States Court.

Messrs. James J. Murray & Co., manufacturers of arc light globes and incandescent shades of all the various colors, styles and shapes, etched, opal and other kinds, whose works are located at Trenton avenue, Culvert and Waterloo streets, this city, report that they have been unusually busy during the entire season. They have recently made many shipments to South America and Canadian points, and their goods are well known and favorably regarded by the electric light trade, both in this and other countries. They report prospects for the year '92 as being unusually bright, and expect a constant and increasing business.

The electric lighting business appears to be profitable, says the *Ledger* in a recent issue. "Although the Edison company in this city has declared no dividends, applying its profits to extensions, a stockholder declared recently that its net earnings were sufficient to pay a 12 per cent. dividend. It is, moreover, doing all the business for which the station is equipped. Although the electric light costs more than gas, and it is troublesome to introduce it in old houses, yet it may count on a steady growth of business as its mains are introduced in residence sections. The incandescent light more than fulfills all the promises made for it by Mr. Edison 13 years ago, but it has had no such effect on gas companies as was then anticipated."

W. R. W.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 28, Hathaway Building, 620 Atlantic Ave.,
BOSTON, Mass., Jan. 30, 1892.

The New England Electric Club will hold a special meeting Wednesday evening, Feb. 3, at the Tremont House.

Petitions are being circulated in the interest of the electric street railway from Marlboro to Westboro, and are being signed by those interested in both places and in Hudson.

Mr. Charles J. Van Depoele, the inventor and the electrician of the Thomson-Houston company, who has been seriously ill with the grip at Lynn, is now considered out of danger.

The Post Engineering Company, of Boston, is doing a constantly increasing business installing steam and electric plants and is well equipped in every way to handle anything in these lines.

The Lynn & Boston Street Railroad Company's stockholders will meet Feb. 3, when the proposition to issue coupon 5 per cent. 20-year notes to an amount not exceeding $300,000 will be considered.

The Erie Telephone Company's executive committee will meet Feb. 5 to consider a dividend question. It is stated that the earnings of the company for the quarter ending Dec. 31 will show an increase over the same quarter for 1890.

The Holtzer-Cabot Company, reports that the demand for the new motors, which the company is bringing out, is something entirely unexpected and has been as pleasing as it is surprising. A new catalogue will be ready in about two weeks.

Messrs. Drake, Payson & Whittier, the Rhode Island agents for the Eddy motors, are meeting with such success with their sales that they found it necessary to keep in stock a full line of the machines from ⅙-h. p. up to meet the demands.

The Porter-Leavitt Motor Company, of Providence, R. I., is building a new factory which will be ready for occupancy in about a week. This was made necessary by the rapid increase in business and will give a capacity of 100 motors per day.

The American Circular Loom Company is distributing samples of old wire, before and after covering with the patent woven process, which shows the advantages of this treatment of covered wire that has become worthless for insulating purposes.

The Electrical & Mechanical Manufacturing Company, of Providence, R. I., manufacturers of the new "E. & M." single and double pole switches, are running to their full capacity and have orders on hand which they state they will not be able to fill for some time to come.

Laminar Fibre Company.—The insulating material manufactured by this company is in use by nearly all of the principal electrical companies and the demand is constantly increasing for the same. It comes in any shape wanted, is easily worked, has the finest insulating qualities, and it is no wonder that it should be popular.

C. A. B.

WESTERN NOTES.

BRANCH OFFICE OF THE ELCTRICAL WORLD,
465 THE ROOKERY, CHICAGO, Jan. 30, 1892.

Mr. D. B. Dean, of the Electric Merchandise Company, left for New York on Thursday.

Mr. William Bracken, of New York, is one of the welcome visitors in Chicago this week.

Mr. J. A. Long, president of the Akron Iron Company, of Akron, O., was a guest at the Auditorium this week.

Mr. J. B. Wallace, of the Electrical Supply Company, Ansonia, Conn., dropped in to see Mr. Terry this week.

President Pond, of the Pond Engineering Company, dined at the Chicago Electric Club, on Wednesday of this week.

Mr. W. J. Pilley, the tourist of the Illinois Electric Material Company, of Chicago, has started out on a business trip.

Mr. E. L. Babcock, president of the Falls and Rivet Machine Company, Cuyahoga Falls, O., was in Chicago for several days this week.

Mr. J. H. Rhomberg, of the Dubuque Street Railway Company, was in Chicago this week looking up the question of rapid transit.

Mr. F. L. Merrill, the Chicago agent of the Consolidated Electric Storage Company, has secured several handsome orders this week.

Mr. C. D. Crandall, manager of the Western Electric Company, Chicago, returned home this week after a flying business trip to the West.

Mr. F. S. Terry's many friends will be glad to learn that he has fully recovered from his late attack of incipient pneumonia and is again at his desk.

Mr. W. H. Fitzgerald, the general manager of the Detroit Electric Light and Power Company, dined at the Chicago Electric Club on Wednesday.

Mr. N. J. Stambaugh, secretary of the Falls Rivet and Machine Company, Cuyahoga Falls, O., is looking after the interest of the Chicago office for a few days.

J. Lang & Co., Michigan street, have on hand ready for immediate shipment the usual heavy supply of Andrews switches and of gas tight combination attachments.

The Illinois Electric Material Company has secured the agency of the Pennsylvania lamp, and has already a sufficient stock on hand to promptly supply any orders placed.

Mr. R. J. Randolph, well known to all the electrical fraternity in the West, and one of the first to enter the electric lighting field, has secured the agency of the new Lieb motor.

Mr. L. E. Myers, specialagent of the Detroit Electrical Works, has opened a handsome office at No. 431 The Rookery, Chicago, and has models of the Standard street railway system on hand.

Mr. W. R. Mason, manager of the Electric Merchandise Company, returned from New York on Thursday with Mrs. Mason, where he was called by the death of a sister of Mrs. Mason.

Mr. L. K. Comstock has opened an office in room No. 341, The Rookery, Chicago, and will prepare plans and specifications and do the general work of a supervising electrical engineer.

Mr. La Fayette Cole, of Holmes, Booth & Haydens, arrived in Chicago on Tuesday en route from San Francisco to New York. As usual, Mr. Cole has some nice orders for K. K. wires in his pocket.

Mr. J. M. Thomas, the genial secretary of the Chicago Belting Company, has been laid up with an attack of pneumonia, but is convalescing and will soon be out again to greet the many callers at his office.

Mr. C. A. Brown returned to Chicago this week from an extended Eastern trip, where he has been busily engaged in taking testimony in one of the important suits in which electrical companies are interested.

Electric Light Building Burned.—The Hyde Park Electric Light and Power Company's plant at Forty-first street, near Cottage Grove avenue, was burned to the ground recently, entailing a loss of $3,000, principally by damage to three large dynamos.

Inspecting Chicago's Electric Lights.—Mayor A. W. Doan, of Wilmington, O., and Aldermen A. J. Martin, W. R. Shrieves, Robert McMillan, Frederick Weltz, J. J. Lewis, Z. Walb, and W. H. Runnells are inspecting Chicago's electric light system.

Kohler Brothers, the western agents of the Eddy Electric Manufacturing Company, have sold two handsome motors this week. This firm consists only of G. A. Kohler and Franklin W. Kohler, Mr. T. G. Grier having withdrawn to give his entire time to pushing the sale of Paiste's specialties.

Mr. J. F. Schaefer, the incandescent lamp expert, is busy fitting up the handsome offices and extensive factory of the Illinois Electric Lamp Company in the new manufacturing building, Nos. 171 and 173 South Canal street, Chicago. This factory will be completely equipped with improved machinery and customers may expect to secure lamps about March 1.

Mr. F. W. Weir, manager of the Chicago office of the Falls Rivet and Machine Company, has resigned that position to enter another line of business. This will be a source of regret to all who have had business relations with Mr. Weir, for he has won a host of friends by his genial courtesy and strict attention to business. Mr. Weir takes with him the best wishes of the officers of the Falls Rivet Company, who would gladly have arranged to retain his services.

Frank Bros., one of the firms sued by the Brush Electric Company for alleged infringement of the patent for double carbon arc lights, have filed their answer in the United States Court claiming they are not now using the lamps sold by the Sperry Electric Company, but believe that the Sperry lamp is not an infringement of the Brush patent, and that, although defendants did use the Sperry lamps, they made no profits therefrom and complainant is not entitled to recover damages.

The Pond Engineering Company has secured handsome store rooms on the ground floor of The Rookery, Chicago, and will at once fit them up for the transaction of it rapidly increasing business, which has far outgrown its present quarters on the fourth floor of The Rookery. The main room will be 56 × 14 feet and will be divided by a partition placed across the centre. The rear portion will be converted into a store room, ample access being obtained through the alley, thus securing excellent facilities for handling freight.

The Chicago Electric Club will meet Wednesday evening, Feb. 3. The following is the programme of the evening: "The Necessity and Present Opportunity for the Establishment of a Technological Institution with Physical Laboratory and Museum of Mechanical Arts in Chicago," Francis W. Parker. Discussion: "Attitude of the Electrical Interests," B. E. Sunny; "Benefit to Public Works and Municipal Corporations," Hon. John A. Roche; "The World's Fair and Such an Institution," Hon. A. H. Revell; "The Interest of Manufacturing Industries," W. J. Chalmers; "Financial Prospects," J. J. P. Odell; "The Attitude of the University of Chicago with Regard to Technological Education," Dr. Wm. R. Harper.

President Wm. P. Hall, of the Hall Electric Signal Company, of New York, has secured the largest contract ever given by any railroad company for automatic signals. The contract calls for the erection of 200 block signals, to be placed at an average of five-eighths to one and one half-miles apart, the total trackage to be covered by the signal system being eighty-seven and one-half miles. In addition to the signal blocks the railroad company has contracted for fifty-two electric alarm bells for street crossings. President Hughitt, General Manager Whitman, and Assistant Engineer Carter of the Northwestern went East three weeks ago to investigate the various signal systems. They decided on the Hall automatic electric block system as the one suited to the company's needs. The Northwestern's surburban traffic is already enormous, and it is expected that the World's Fair will increase it at least one-half. This will necessitate the putting on of more trains, and the old system of keeping track of the trains by signals worked by telegraph operators, the officials think, will be inadequate. The automatic electric signals will be put on the different divisions, as follows: Galena Division, from Fortieth street to Turner Junction; Milwaukee Division from Claybourn Junction to Waukegan; Wisconsin Division, from Claybourn Junction to Barrington. Eighty-seven and one-half miles will be covered and 200 signals will be used, placed on an average of three-fourths of a mile apart. One hundred and eighty-eight switches will be protected.

The use of electricity at the Union Stock Yards by the well known firm of Swift & Co. in lighting the grounds and buildings of their extensive plants in Chicago, and in Omaha and Kansas City and also in many of their warehouses scattered throughout the country, is very noteworthy. In the main buildings in Chicago there are over 8,000 incandescent lamps wired in circuit, while the combined stations have a dynamo capacity of 1,600 National (Eau Clair), 2,000 Slattery and 3,000 Edison; then there are over 100 Brush arc lights and several motors. In Kansas City 1,500 Slattery incandescent lamps and 60 Wood arc lights are used, while in Omaha there are 1,200 Slattery incandescent lights and 40 Wood arc lights. Some idea of the enormous volume of the business transacted by Swift & Co. may be gathered from the statement that at the Union Stock Yards alone there are over 5,000 men employed. Four years ago they had a total of about 1,000 lights in service, and the various extensions resulted in giving their former electrician, Mr. Kenneth McLennan, a wide and valuable experience in installation work in both wet and dry places, for there are lamps burning in the dry machine and wood departments, the car shops and similar places and also in the hide cellars, the cooling rooms, tank rooms and other points where moisture abounds. It was no light task to maintain a high insulation resistance under these varying conditions, and the success that attended his efforts indicates the careful manner in which the subject was studied by Mr. McLennan.

F. DE L.

CLEVELAND, O., Jan. 30, 1892.

The Dupont Motor Truck, manufactured by Dorner & Dutton, of Cleveland, is used by the Short company, and they speak very highly of it.

Mr. I. H. Moses has bought out the interest of Mr. A. B. Lyman in the firm of A. B. Lyman & Co., and will continue the business for the present under the old name.

The Ford & Washburn Electric Company seems to be doing some good electrical work in a quiet way. Mr. Washburn has been confined to his home by illness, but is now able to be about.

Hewitt & Co., on South Water street, are paying considerable attention to the manufacture of electrical specialties. Mr. Hewitt was formerly connected with the East Cleveland electric railway.

The Buckeye Electric Company, of which Mr. C. H. Rockwell is treasurer and manager, and Mr. Arnold Spiller, electrician and superintendent, has moved into its new factory at 1925-29 Broadway. The company confines its business to the manufacture of incandescent lamps, and now has facilities for turning out 5,000 a day.

The Hill Clutch Works are as busy as usual. Practically, if not absolutely all their work is done for electric light and electric railway companies. Mr. Leonard expects to have all the delegates to the forthcoming electric light convention visit Mr. Huntley's new station, in Buffalo, to see the handsome clutch pulleys and other apparatus installed there by the Hill Clutch Works and they will certainly be amply repaid for the effort.

The Carbon Business in Cleveland was never much better than it is just now. The Brush, the National, the Standard and the Globe companies are all running to their full capacity. Mr. B. F. Miles, vice-president of the National Company, is as active and also as smiling and serene as usual. It is thought that if the citizens of Fremont do not offer to the Thomson-Houston tempting inducements to remain, the factory of that company may be moved to Cleveland.

The Brush Electric Company is busy filling among others a large order for a new outfit of machines to take the place of those destroyed in the recent fire in Boston. Mr. Potter, the treasurer of the Brush Company, still continues to direct the affairs of the company, though Secretary Hammil and his assistant, Mr. L. B. Le Vake, look after many of the details. The company continues to do a large business, and also manufactures most of the apparatus for the Short system, which gives it enough work to keep several good sized factories reasonably busy.

Prof. Sidney Short contemplates with much satisfaction the progress that his company has made and is making, and he has every reason to feel gratified over it. Go to his office at any hour of the day, and you will find from one to half a dozen street car men who have come to confer with him or with Mr. Higgins, the general manager, about adopting the Short system. The Professor and Mr. Higgins are much pleased over several nice contracts they recently received. The latest order was from the Pittsburgh and Birmingham Traction Company, of Pittsburgh, Pa., for 60 of the latest type of Short single reduction 30-h. p. motors.

A test was made a few days ago by a well known Cleveland engineer of the Short gearless motor in competition with single reduction gear motors of the Short, Thomson-Houston and Edison types. The method employed was to connect the cars in pairs with a dynamometer between them, and then use each alternately as motor car and as trail car. The results showed that the gearless machine gave a performance quite as satisfactory as any of the single reduction motors, so far as a careful test of this kind could show. The motors of the Short company used in the tests are what are known as the "Pitsburgh" type—made for exhibition at the Street Railway Convention last October. The new motors since put on the market by the Short company are more efficient.

ERIE, Pa., Jan. 30, 1892.

The Sterns Manufacturing Company, of which Mr. John T. Boyd is manager, is supplying a large make of Woodbury self contained high-speed automatic engines for driving dynamos, and making a strong bid for electrical trade.

The Edison Electric Light Company, of which Mr. C. H. Strong is president and Mr. Henry Tibbals secretary and treasurer, has one of the finest central stations of any city of the size of Erie that the writer knows of. The business of the company is rapidly growing.

The Erie City Iron Works, of which Messrs. Geo. Seldon and Geo. D. Seldon are at the head, also manufacture an automatic engine that is highly spoken of by electric light and electric railway managers, and will attract more attention from these classes as its merits become better known.

The Lovell Manufacturing Company, an old established and prosperous concern doing a large business in hardware specialties, of which Mr. M. N. Lovell is president and general manager has gone into the manufacture of the Niagara motor and dynamo and of other electrical specialties, principally the inventions of Mr. V. J. Mayo.

The Manufacture of Steam Engines is, of course, what Erie is principally noted for. The Ball Engine Company, of which Mr. Jas. McBrier is president, and his son, Mr. D. N. McBrier, secretary, confines its attention wholly to the manufacture of high-speed automatic engines for electric lighting and electric power service, and the factory is kept about as busy as it well can be.

The Erie Electric Motor Company, of which Mr. J. S. Casement, of Painesville, is president, and Mr. Jacob F. Pfetch, of Erie, general manager, is not a manufacturing company, but devotes its energies to the operations by the trolley system of the various street car lines of Erie. This work the company does apparently to the satisfaction of the citizens, for it is continually increasing the number of its motor cars.

Wooden pulleys have been manufactured in Erie since 1873, and it is said that the Taper Sleeve Pulley Works, of which Mr. A. H. Gray is proprietor, are the oldest manufacturers of wooden pulleys in the world. Many electric light and electric railway companies use the Taper Sleeve pulleys, and more would do so if Mr. Gray were less modest about drawing their attention through THE ELECTRICAL WORLD to the advantages of his pulley.

Tempered Copper for electrical purposes, the manufacture of which is one of the most recently established industries of Erie, is being placed on the market by the Mitchell-Brant Copper Company Mr. Daniels, formerly of the Eureka Tempered Copper Company and Mr. Thos. Brown, a well known business man of Erie, are connected with the Mitchell-Brant Company, regarding which electrical companies are likely to hear more before very long.

Motor and Dynamo Building seems to be coming to the front in Erie. The Keystone Electric Company, of which Mr. John W Leach is manager, occupies a whole building devoted to the manufacture of the Keystone dynamo and of its ingenious and now pretty well known reversible motor for running elevators. The motor is simple and compact, and can be reversed instantly and the elevator started in the opposite direction without the use of a rheostat.

KANSAS CITY, Mo., Jan. 27, 1892.

Mr. Geo. E. Claflin, of the Franklin Electric Company, is east on a business trip.

The Western Electric Construction Company has had its establishment closed for some time.

Mr. M. D. Wood, Manager Western Union Telegraph Company, is in Oklahoma attending a meeting of Knights of Pythias.

Moberly, Mo., is paying $10 a month for arc lights, and is seriously contemplating putting in a plant to be owned by the city.

Bethany, Mo., is clamoring for a telephone connection with St. Joseph, Mo. Leading citizens have taken the matter up with the Missouri & Kansas Telephone Company, and in all probability a line will shortly be put in.

Contracts have been let for the new county court house. The National Electric Company will put in the dynamos and make all connections. Two machines will be installed, aggregating 100,000 watts, and it will undoubtedly be the finest private plant in this city. Mr. Thos. H. Clohesy secured the contract for wiring the tunnel and will begin work at once. The court building was wired by Mr. L. C. Bair, who finished the work without a single ground or short circuit, using 26,000 feet of Grimshaw wire.

H. D. E.

LINCOLN, Neb., Jan. 26, 1892.

Several Omaha capitalists have been in the city looking over the prospects for business with a view to locating an electrical enterprise.

The Beatrice Rapid Transit Company.—Within the next 30 days this company intends increasing its power apparatus and installing new incandescent machinery.

F. Maxwell, manager of the Beatrice Electric Light Company, has been in the city purchasing supplies Mr. Maxwell intends duplicating his Westinghouse alternator shortly.

M. O'Reilly has installed an electric motor in his repair shop and is working night and day endeavoring to fill the demand for armatures that have been injured during the cold snap on the different street railways.

Mr. J. Chase, of Weeping Water, is negotiating for the purchase of the large sewing machine factory at that place. If the factory can be secured at a reasonable price, Mr. Chase intends locating his electric light plant there, and manufacturing all kinds of electric specialties, motors, etc.

The Lincoln Electric Manufacturing Company, manufacturer of the Diamond lamp, is moving its factory to Denver, where it has a contract with the Denver Consolidated Lighting Company for 30,000 16 c. p. lamps for stock and a running order for 250 lamps per day.

There has been quite a demand in this vicinity for a cheap motor of which the speed could instantly be controlled for dental and other purposes. Mr. H. Askin has designed and built a machine that it is stated fills all the requirements to a nicety. It is series wound, and is operated from acid batteries at a trivial cost.

The Lincoln Electrical Manufacturing Supply Company.—The increasing demand of business has compelled the company to seek new and more roomy quarters. It can now be found in the Masonic Temple, where it would be almost impossible for a person at all interested in electricity to pass the showy salesrooms without giving them a call.

H. A.

TACOMA, Wash., Jan. 23, 1892.

The Commercial Electric Light and Power Company, W. B. Bushnell, president, has ordered a 200-h. p. Westinghouse compound engine, which will be added to the present equipment of its station.

The Tacoma Light and Water Company, Theo. Hosmer, president, has increased the number of arc lamps used in lighting the city streets, and is now operating over 700 arc lights and the number will soon reach 800.

The Consumers' Electric Supply Company has taken the local agency for the Northwestern Thomson-Houston Company. It has recently wired the new Baker building and is preparing to rapidly extend its business.

The Point Defiance Electric Railway, which recently adopted electric equipment, is giving great satisfaction. Edison single reduction motors are used. The new 33-foot cars were recently received, each having two motors of the above type.

The Light, Heat and Power Syndicate, of Tacoma, has added a 300 light Mather dynamo to its central station in the Washington Building, and is preparing to light the new Baker Building with 150 incandescent lamps. The mains are all underground.

The A. F. Esperson Manufacturers' Company has successfully inaugurated its lighting system, taking current from the Tacoma Railway & Motor Company's power circuits. It recently installed a plant of this kind in the Tacoma Grocery Company's new building, operating 107 lights and an Otis freight elevator.

The Northwest Supply Company, Chas. S. Bowie, manager, has been awarded the contract for wiring the new City Hall for an 800 light installation, Edison system. This company has recently installed a 100 incandescent light plant, with an Eddy dynamo, in the Puget Sound Flouring Mills. A Rice automatic engine supplies motive power.

The Tacoma Railway and Motor Co. has received a new Edison railway generator, 175 kilowatts capacity, and several more have been ordered. A 30 and 44 by 48 Corliss tandem compound engine has been purchased which was recently completed at the Frick company's works, Waynesburg, Pa. The company furnishes current for the Point Defiance railway cars, besides supplying its own lines.

The Tacoma & Steilacoom Railroad Company (electric) has been reorganized, and will extend the field of its operations. The new officials are president, E. B. Kittle; secretary, S. B. Livermore; trustees, H. M. Byllesby, St. Paul; Howard C. Lewis, St. Paul; H. W. Goode, Portland; F. E. Sander, Seattle; E. B. Kittle, Seattle; R. S. Hill and S. B. Livermore, Tacoma. It is given the power to build and sell railroads in Tacoma and Pierce county; to buy and sell land, and to have all the privileges necessary for the management of a railroad and general land company.

The Edison General Electric Company has made some changes in its affairs in the Pacific Northwest, and Mr. Preble has resigned his position. It is rumored that this company will very shortly open general offices in Tacoma. The company, through E. B. Parsons, local superintendent of construction, has installed a 2,000 incandescent light plant in the Northern Pacific Railroad Company's "Edison shops," in Tacoma. Four Edison 25-kilowatt dynamos are used, driven by two 80-h. p. Seymour & McIntosh automatic engines. Two electric transfer tables are operated from the same plant.

G. R. DeV.

CANADIAN NOTES.

OTTAWA, Jan. 29, 1892.

Perth, Ont.—A scheme is on foot to build an electric railway between Perth and Lanark, outside parties to furnish capital and own the road.

Quebec.—The Quebec & Levis Electric Light Company is advancing the price of lighting the city streets by $10 per light per annum. The old contract is about expiring. The Council have under consideration a scheme for the city to do its own lighting.

Montreal.—In the case of Leonard vs. the Royal Electric Company, which is an action to recover $8,000 as the price of machinery furnished the defendant to establish its system in Three Rivers, Judge Loranger has ordered the proceedings to be suspended until the month of April pending the issue of another action taken by the defendant against the city of Three Rivers, which refused to accept the machinery.

Ottawa, Ont.—The Ottawa Electric Street Railway Company is experimenting on a patent air brake. The brake is the invention of Major Chapleau, who is supervising its construction. It is on something the same principle as the Westinghouse air brake and if successful all that will be necessary to stop a car in very quickly will be merely the moving of a controller similar to that used in turning on the electric current to start the car. The first of the electric cars heated by electricity was run last week, and the result was in every way satisfactory. The heaters are placed under the seats on each side of the car, are entirely out of the way and can be regulated so as to comfortably heat the car without making it too hot.

F. L. J.

ENGLISH NOTES.

LONDON, Jan. 20, 1892.

Sir William Thomson.—The peerage which the Queen conferred on Sir William Thomson on New Year's day has, it is needless to say, given universal satisfaction, even the reddest radical papers admitting that the title is well earned. I understand that he will assume the name of Lord Kelvin, the Kelvin being a small stream which runs past the windows of his residence in Glasgow.

Revenue of Exhibitions.—A detailed analysis of the receipts and expenditures connected with the Paris Exhibition of 1889 has just been published. The net financial outcome of the exhibition is a balance of about £190,000 to the good. As, however, the State contributed no less than £680,000 toward the expenses of the exhibition, and the city of Paris also assisted it financially, this profit is more apparent than real. On the other hand the accounts of the Frankfort Exhibition, which have also just been issued, show that there has been a profit of £7,000. The receipts amounted to £75,700 and the expenses to £68,100.

A Subway Explosion.—The daily papers contain what on the face of it seems to be a characteristically sensational account of the results of a short circuit on the mains of the Liverpool Electric Supply Company. According to these authorities the frequenters of the shopping district of Liverpool were startled early on Monday afternoon by the sudden bursting of a flame from between the flagstones of the pavement. The flame increased to a blaze and the pavement began to break up. Finally the conflagration was subdued by the combined exertions of policemen and electrical experts. The phenomenon is attributed to a short circuit resulting in the burning of the insulating coverings of the mains.

The National Telephone Company and Its Subscribers.—An action which has been brought in the Dundee Small Debt Court by the National Telephone Company against one of its local subscribers promises to be of considerable interest to the telephoning public at large. The telephone company is suing the local firm for telephone rental from November, 1891, to November, 1892, payable in advance. The defense set up is that the service has been so abominably bad that the contract has become void. In the judge's opinion the point to be decided is whether or not this bad service if proved is willful and due to persistent neglect. The defendants allege that it is in a sense willful, since the company's staff is both inefficient and insufficient. It is difficult to see, however, in what way a contract containing the following clause can possibly be voided. "The company shall not be liable for any loss or damage occasioned by the interruption of telephonic communication *from any cause whatever.*" Be the issue of the action what it may, it will ventilate a question of considerable public importance, and may possibly deter future telephone subscribers from signing such absurdly one-sided contracts. In this country at any rate we still have the whip hand of the the telephone company, in as much as the telephone has not as yet become indispensable to the average British citizen, while the average British citizen's subscription is highly in dispensable to the National Telephone Company. In the course of the counsel's arguments it was stated that it had become quite a proverb in Dundee that since the advent of the National Telephone Company the use of bad language had considerably increased.

House Wiring Company.—The cause which, next to the high price of electricity as compared with gas, chiefly militates against the general introduction of the electric light into the houses of the majority of Londoners, is the great cost of wiring and the fact that the whole of the fittings which come under the headings of "fixtures" become landlord's property on the expiring of the lease. The majority of London houses being held on short leases makes this consideration of primary importance. A company called the Electric Fittings, Hiring and Maintenance Company has now been formed with a capital of £200,500, for the purpose of facilitating the introduction of the electric light by executing all needful work inside houses, the payment being spread over a term of five years. This company proposes to guarantee all its work and to maintain the same free of cost, including the replacement of all fittings and materials throughout (except lamps) during the period of hiring. The prospectus of the company, of course figures out 10 per cent. dividends and a large business. The objects of the company are in every way deserving of praise and, what is more to the point, of profit, but before the hindrance to the general introduction of electric lighting can be overcome it will be necessary to modify the law of landlord and tenant and to alter the custom which now so generally obtains of seven years' leases. The majority of people who wish to take the electric light are not deterred so much by its cost as by the fact that they object to spending several hundreds of pounds on fittings which in a few years' time will become landlord's property, and this defect the Electric Fittings Company scarcely meets.

Crystal Palace Electrical Exhibition.—The Electrical Exhibition at the Crystal Palace, although shorn of the many features which we were told would be prominent, was unable to present itself in a complete state to the public on the nominal opening day (Jan. 9), although this had been postponed for a week beyond the date originally fixed. Art fittings and switches, of course, predominate, but there is also a fairly representative show of heavy machinery. The most striking exhibit in this department is a combined 8-pole 13-unit Kapp dynamo and Davey-Paxman triple expansion engine The exhibits of Messrs. Siemens Bros. & Co. and of Crompton & Co., Ltd., promise to be good specimens of heavy engineering; while those of the Brush Company, Woodhouse and Rawson United and Swinburne & Co are almost, if not quite, complete. The firm of Messrs. Siemens propose to repeat their extraordinary 50,000-volt arc experiments, and I hear that Mr. Swinburne proposes, by the combination of transformers and condensers, to obtain electric discharges of high frequency and of the enormous pressure of 100,000 volts. Examples of the applications of electricity to mining and traction are unfortunately conspicuous by their absence. Among the novelties may be mentioned two new systems of electric conduits, one, the invention of a Captain Morgan Grenville, consists of iron piping and bare copper conductors, the insulation being long glass beads which are slipped on over the conductors; the other consists of square blocks of wood soaked in creosote and pierced with large ducts. Another comparative novelty were the various switch bases and other similar articles made of the porcelain called "petrammite." This material, which is of a beautiful snow white hue, is said to be composed of practically pure silica. It is molded under pressure, and is said to be stronger than porcelain and not to condense moisture on the surface. Another novelty was the method employed by the Brush company for obtaining a rubbing contact for the excitation of the field magnets of their Mordey alternators. This consists simply of two long highly flexible strips of copper gauze slung over the rings and weighted at the extremities.

News of the Week.

THE TELEPHONE.

American Bell Telephone Company has been granted an extension of time by Justice Colt in the United States Circuit Court to Oct. 1, to put in testimony in the case of the Government vs. The Bell Telephone Company.

The Rocky Mountain Telephone Company contemplates putting in an exchange at Livingston, Mont., it is reported, and will probably extend the lines to Big Timber, which will give Helena direct communication with Lewiston.

The Heard County Telephone Company operates a line connecting Hogansville, Ga., with Franklin. It is said to be a profitable investment and although the line has only been established a short time, the stockholders have already realized a dividend of about 40 per cent. on the capital invested.

Bell Telephone Output for the month ending Jan. 22 was as follows:

	1891-2.	1890-91.	Inc.	Dec.
Gross output	5,633	4,165	1,468	....
Returned	4,236	3,118	1,118	....
Net	1,397	1,047	350	....

THE ELECTRIC LIGHT.

Moundsville, W. Va.—A new dynamo is to be added to the electric light plant of the Moundsville Electric Light Company.

The Walla Walla Gas and Electric Company, of Walla Walla, Wash., is to expend $60,000 in improvements to its plant.

Waterville, Me., is now lighted by the new municipal electric lighting plant recently completed. Fifty eight arc lamps are used.

Williamston, Mich.—The City Council has contracted with the Western Electric Company for electric lights, to be in operation by April 1.

Denton, Tex.—It is stated that if the water works prove

a success the city will at once contract for a complete system and an electric lighting plant.

Helena, Mont.—John F. Cowen, of Butte, has filed his acceptance of the electric light franchises, and a bond of $1,000 to be forfeited in case the work is not completed.

The Edison Light and Power Company, of Minneapolis, Minn., have recently started a 300-h. p. Ball cross compound engine furnished by the Ball Engine Company, Erie, Pa.

Aspen, Colo.—An ordinance has been passed by the City Council granting S. N. Hurd and others the right to erect an electric light plant to furnish electric light and power for a period of 25 years.

An incandescent plant on the Edison system is being installed in the Whitaker mill, Wheeling, W. Va. N. P. Horner, of Hix, Crosby & Co., of Baltimore, is superintending the wiring. There will be 250 or 300 lights of 16 c. p.

Electricity in Mining.—The Stow mine at Forbestown, Cal., is to be lighted by electricity. The machinery will be run by water power. The miners will use incandescent lamps to work by. This is the first mine to use electric lighting.

The Uxbridge & Northbridge Electric Company, of Uxbridge, Mass., at a recent meeting considered the purchase of property at Riverdale for a new power house, which, if made, will necessitate an increase in the capital stock.

Bunker Hill, Ill.—The committee on lighting at a recent meeting of the City Council recommended that the city enter into a contract for a system of electric street lighting. The recommendation was adopted. It is stated that incandescent lights are in favor.

New Orleans, La.—Mayor Shakespeare has vetoed the electric light ordinance relative to the payment to be made to the Louisiana Electric Light Company, which ordinance appropriates $3,150.60 to the company mentioned to carry out the "intent" of a certain ordinance.

The Greenwich Electric Light and Power Company, of Greenwich, N. Y., has recently put a 30-inch horizontal turbine in at Middle Falls for the purpose of furnishing electric light and power at Greenwich. It is also contemplated to furnish lighting and power to the town of Cambridge.

The Santa Fe Railroad Company is having its St. Joseph passenger trains equipped with storage batteries for electric lighting, Mr. Geo. H. Price, of Topeka, Kan., electrician of the company, is superintending the work. If it proves a success the Denver and California trains will be similarly fitted out.

The New Iberia (La.) Electric Light and Power Company had an accident to its machinery recently which, it is stated, will cripple the plant for some time. Some of the parts of the dynamo, due to wear, were taken off and replaced by new pieces. The machinery was started for a trial which was followed by an explosion and the bursting out of flames. The machinery was damaged to the extent of several hundred dollars.

Elizabeth City, N. C.—The electric light plant which will be erected by the Improvement Company is to be equipped at once. Mr. E. F. Aydlett writes that bids have been sent out for the fixtures and machinery. Cash will be paid for everything. Two boilers of 50 h. p. each and one engine of 85 or 90 h. p., two dynamos, one arc of 35 to 40 light, 2,000 c. p., and one incandescent machine of from 500 to 650 light capacity, with wire, lamps and fixtures, will be required.

To Light Mount Washington.—It is reported that Mount Washington is to be capped by the largest electric search light ever made, one that can easily be seen from Portland, Me., and under favorable conditions from Boston. A company is to be organized to carry out the scheme. It is believed that the light on the summit of the mountain will be such a novel and beautiful spectacle that it will benefit the State of New Hampshire, simply viewed as an advertisement. Some one has facetiously remarked that an attempt would probably be made to project advertisements on the clouds by its aid.

The City of Melbourne, Australia, is about to install a municipal electric light plant, and in this issue of THE ELECTRICAL WORLD invites tenders from America for supplying the necessary apparatus. About 15 dynamos, 633 arc lamps and 12,000 series incandescent lamps will be required, besides switchboards, armatures, lightning arresters and 160 miles of insulated cable and 12,000 insulators. For the convenience of American companies wishing to make bids, the authorities at Melbourne have sent to THE ELECTRICAL WORLD copies of the specifications and conditions under which the tenders are to be made. Those interested can obtain same on application to this office.

THE ELECTRIC RAILWAY.

An electric railroad is contemplated between Huntington, W. Va., and Ashland, Ky., a distance of 16 miles.

The Metropolitan Street Railway Company, of San Francisco, Cal., has petitioned the City Council for permission to make extensions of its electric system.

Mr. Wm. A. Lynch, manager of the Canton (O.) Electric Light Company, contemplates connecting Canton and Massillon by an electric railway. The distance is twenty miles.

The Wilmington City Railway Company, of Wilmington, Del., has petitioned the City Council for permission to lay its tracks and equip its lines for an electric system.

Boulder, Colo.—It is stated that parties from the East have recently purchased the street railway lines of this city and intend to equip the same electrically and extend the lines eight miles.

The Braddock Electric Street Railway, of Braddock, Pa., has been put in operation between Bessemer and Hawkins. It will be some time before the route through Braddock will be completed.

The Thomson-Houston Electric Company has been awarded the contract for building the electric street railway lines at Rome, Ga. It is expected the lines will be in operation in about 90 days.

The Brooklyn City Railroad Company's application for permission to change the road's motive power on its entire lines to the electric system has been granted by the State Board of Railroad Commissioners.

Pittsburgh, Pa.—The board of directors of the West End Street Railroad, who recently decided to equip the road with electricity, expect to have the system completed by July 1, the anniversary of the opening of the road.

An electric rapid transit line is projected between Newark and Passaic, N. J., passing through Harrison, Kearny, Arlington, Kingsland, South Rutherford and Passaic, and connecting with the Passaic & Paterson Electric Railroad.

The Villard Syndicate has leased the Milwaukee & Wauwatosa Rapid Transit line, which will be operated in connection with the Milwaukee electric system. It is understood that the lease is for a year, and is a temporary arrangement looking to either the purchase or its lease permanently.

The New Orleans (La.) and Carrollton Street Railway Company at a recent meeting of the board of directors accepted the ordinance authorizing the adoption of an electric system. Work will begin as soon as practicable and members of the board will visit the North to inspect the systems in use in the prominent cities.

The Newark and Orange (N. J.) trolley system went into operation on Monday of this week. Twenty cars are to be run on six minutes' headway. The running time from Newark to West Orange is forty-two minutes, a reduction of twenty-five minutes over the horse schedule. We hear considerable talk that the mule must "go," and the horse must "go," but it seems to the present writer as if it is the trolley cars that "go!"

The Union Street Railway Company, of Uniontown, Pa., has let the contract for generators, motors and all the other electrical apparatus for its new power station to the Edison General Electric Company, of New York, through its Pittsburgh representative, I. H. Silverman. The new power plant will have four times the efficiency of the old one. The contract is for two 135-h. p. generators, eight 20-h. p. motors, four 25-h. p. motors and trucks for three cars. The company has also ordered several new cars from the Brill company. Two 150-h. p. engines and three 100-h. p. boilers will be put in.

Hamilton, Ont.—The street railway company is to have opposition in its project to secure a renewal of the lease of the street railway. A new company is being formed under the name of the Hamilton Electric Street Railway Company (limited), with the following gentlemen as directors: George Roach, J. M. Lottridge, Robert Thomson, J. H. Park, R. E. Kennedy, J. J. Stuart, D. R. Dewey and J. V. Teetzel, Q. C., of Hamilton, and H. M. Pellatt, of Toronto. These gentlemen are nearly all stockholders of the Hamilton Electric Light Company, and it is supposed that they desire to furnish both light and motive power for the city. They have petitioned the City Council to sanction their incorporation, and announce that they desire to establish lines of electric street railway in the city and adjoining township.

PERSONALS.

Mr. Bertram M. Tate, of the New York Car Wheel Works, of Buffalo, is a brother of Mr. Tate, formerly Mr. Edison's private secretary and now of the Edison General Electric Company.

Mr. C. M. Morse, of the Buffalo, N. Y., Engineering Company, was in New York on Saturday of last week, and attended the fortnightly dinner at the Engineers' Club, of which he is a member. The Buffalo Engineering Company is paying considerable attention to electrical work, and will probably pay even more attention to it after Mr. Morse shall have met the delegates to the forthcoming electric light convention.

MISCELLANEOUS NOTES.

The Camden Electric Light and Power Company, of Camden, Ark., had its plant destroyed by fire recently. The loss was several thousands of dollars. No insurance.

Electrical Union No. 5,168, through its executive committee, has sent out copies of the by-laws of the union which were enacted at its last regular meeting, accompanied by an address to firms and contractors in the electrical trade, calling attention to the by-laws of the union, and stating its objects and desire to co-operate in upholding and elevating the standard of labor in the trade, and aid in the endeavor to bring to the employer a sure return on the investment made in his business.

Industrial and Trade Notes.

The Charter Gas Engine Company, of Sterling, Ill., is sending a very attractive calendar to its many friends.

The contract for conduits for the electric wires in Jackson Park has been let by the World's Fair Committee on Grounds and Buildings to T. C. Brooks & Co., of Grand Rapids, Mich.

Holmes, Booth & Haydens, the well known manufacturers of the K. K. insulated wires, have secured orders from the far West for a total of five car loads of K. K. trolley and other wires, through Mr. La Fayette Cole.

H. Lamarche's Sons, of 83 John street, New York, dealers in metals, foreign sheet zinc, spelter, etc., are agents for the Vieille Montague Zinc Mining Company, and are furnishing pure zinc for electrical purposes. They report a good demand and a satisfactory business outlook.

Mr. H. K. Porter, of 66 Beverly street, Boston, Mass., manufacturer of the Boston electric wire cutter, reports very encouraging sales. This tool is manufactured in two forms, one for fire department use with automatic hook attachment, and the other without the hook for general purposes.

The Law Telephone Company, of 85 John street, New York, is sending out a novel advertising device concerning the Law battery, which is manufactured by this company. It resembles a folded newspaper, wrapped and addressed, and contains a reference to the exhibit which the company is to make at the World's Fair.

The Canton Steam Pump Company, of Canton, O., has recently brought out a new design of the Miller Duplex plunger pump which has many new improvements, and it is being used for mining, fire purposes, pressure and for supplying boilers with hot water. It is stated that wherever used these pumps are giving general satisfaction.

The Electric Appliance Company has been mailing circulars containing a description of the swinging ball lightning arrester, with a few testimonials received, to the western trade. Judging from the number of replies received, a large number of orders are assured from those who state that they will use the arresters as soon as necessary.

The Standard Fibre Ware Company, of Mankato, Minn., in order to show its appreciation of the good work done by its faithful employés, not only increased their salaries, but also presented each with a check amounting to three per cent. on the total amount paid to each last year, and granted its ten traveling men each a two weeks' holiday on full pay.

Mr. R. P. Frist, superintendent of the Delaware Hard Fibre Company, of Wilmington, Del., has recently been granted a patent on a spiral wound tubing. Under this patent, tubing can be made any length desired, which is a great advantage, as heretofore the longest length of fibre tubing was 25 inches. It is said to be especially adapted for conduits and interior work.

The B. F. Goodrich Company, of Akron, O., has used excellent judgment in the selection of a substitute for the usual calendars sent out by so many firms at this season of the year. The specimen we have received from this company is a very handsome lithograph about 15 × 22 inches, of the well known head of "Isabella," and is one of the few prints of this kind that is sufficiently artistic to be an ornament to the walls of any business man's office.

The Short Electric Railway Company, of Cleveland, O., has secured from the Minneapolis Street Railway Company an important contract for their entire spring requirements. It will be remembered that this road is one of the largest in the country. In the extensions to be made this spring, the Minneapolis company found it necessary to purchase 120 motors, and made a careful investigation of the latest types of motors, selecting the Short gearless motor. The motors are to be in operation by April.

Messrs. Perrine and Crane, representing the Engineering and Equipment Company, Central Building, Liberty street, New York, have recently been appointed sole eastern representatives of the Syracuse Tube Company, manufactures of tube poles. They are now in a position to handle all orders for railway work. Those who have used these poles state that they give the best of satisfaction. The Syracuse Tube Company has certainly been fortunate in securing such worthy representatives as Messrs. Perrine and Crane.

J. H. Bunnell & Co., of 77 Cortlandt street, New York, dealers in electric railway, telegraph, telephone and electric light supplies, have sent out a neatly compiled catalogue of the various specialties handled by the company. It is illustrated and is made up of 224 pages, giving the prices, of goods and is so arranged that the intending purchaser can gain a clear idea from the illustrations of the goods ordered as well as have a guide and check for the prices. This catalogue is No. 12, and is a credit to its publishers.

The Jerome Kidder Manufacturing Company, of 820 Broadway, New York, recently received the following letter from Mr. W. Wright, of Centreville, Utah: "A few years ago I purchased a physician's office electro-medical apparatus, and received a small book of instructions with it. The book is worn out. Will you please send me another? . . . The machine is yet doing good work."

The Engineers' Investment Company, of 54 Warren street, New York, manufacturers of mathematical instruments and steam engineers' appliances, are the sole manufacturers of the Calkins improved steam engine indicator. A factory has been especially fitted up to manufacture this indicator. The principal features claimed for it are the quality of the workmanship, a correct parallel motion, an adjustable paper carrying device and improved cord carrying pulley. The manufacturers report meeting with most satisfactory sales.

In Excellent Taste.—The number of wall calendars sent out about the first of the year must run well up to a quarter of a million, but for a convenient and attractive bit of necessary desk furniture the celluloid and leatherette calendar case, holding cards covering two years of time, sent out by R. D. Nuttall & Co., No. 179 Grand street, Allegheny, Pa., is especially worthy of note. As these calendars probably cost a quarter each, by the thousand, the number sent out must necessarily be limited, and the demand has probably already far exceeded the supply.

A Handsome Window Display.—The Rutland, Vt., *News* thus refers to the window display at the office of the Rutland Electric Light Company on Merchants' Row and states that it has been one of the features of the street by night, ever since the office was opened. It was designed by Mr. M. J. Francisco, president of the company, and consists of novelties in electric lighting and shows the possibilities of artistic electric lighting. Mr. Francisco has devoted a good deal of time to the study of and perfection of electric lighting, and is recognized by electricians as an expert in this line.

Chas. A. Schieren & Co., of 45 Ferry street, New York, manufacturers of perforated leather belting, recently received the following letter from J. E. Winslow, manager of the Roundhay Electric Tramway, of Leeds, England: "We are ordering to-day from you a supply of your electric belt stuffing, also a supply of your belt cement. Will you kindly send us full instructions for splicing your perforated belts? It may interest you to know that the two belts furnished by you for this plant are giving every satisfaction, and have elicited considerable admiration from English engineers."

Sioux City Engine Works.—It is announced that the business of this company is to be reorganized and that there will be placed at the disposal of the company ample capital with which to carry on the business more extensively than formerly. The business of this company has grown to enormous proportions and it has always been regarded as one of the most important manufacturing industries of Sioux City, Ia. It is stated that the sales doubled in 1891, and the company has a large number of contracts upon its books and a large and valuable stock of material on hand, with excellent business prospects for the future.

The Viaduct Manufacturing Company, of Baltimore, Md., has just issued a new illustrated catalogue containing much valuable information regarding many specialties exclusively manufactured by the company, among which we note a new magneto fire alarm, adapted to all towns, small or large; a new still alarm burglar box for stores, etc.; a new magneto bell with automatic holder for a telephone, and a push button for hotels and elsewhere. The act of pushing the button gives the alarm, but while holding the finger upon it the bell does not ring. This will prove a source of comfort to the ever watchful clerk and save battery power.

The Safety Insulated Wire and Cable Company, of New York, did some quick work during the late storm which prostrated the wires of the electric light companies on First avenue and elsewhere, in filling orders for lead covered cables to replace the pole wires. Orders aggregating several hundred thousand feet were received from the Manhattan Electric Light Company, Mount Morris Electric Light Company, East River Electric Light Company, and the United Electric Light and Power Company. By running its factory until midnight it was enabled to keep all these companies continuously busy on their underground construction until the whole work was completed.

The Roessler & Hasslacher Chemical Company, of 73 Pine street, New York, reports meeting with most satisfactory sales of Isolatine paint. This paint is for inside or outside electrical work, and, it is stated, insures protection wherever used against rust and decay, and its resistance renders it equal to rubber. It dries quickly, and its covering capacity is said to be enormous. It has been subjected to tests which have proved it to be in no way changed or affected by acids, alkalies, salts, gases or water. There is no volatile substance in the dry coat, and after the solvent has left it the coat retains its pliability. The manufacturers send out free samples on application, and detailed information in regard to its merits and use.

Business Notice.

The Mather Electric Motors combine the highest efficiency and workmanship consistent with a reasonable first cost. Perfect automatic regulation of speed from no load to full load. For catalogues and information address E. T. Pardee, agent, 14 Butler Block, Syracuse, N. Y.

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

U. S. PATENTS ISSUED JAN. 26, 1892.

467,505. Electric Switch; Henry Jansen Haight, of New York, N. Y. Application filed Dec. 24, 1890. A compound switch having a contact plate having two contact arms, and an electric conductor with which said contact arms are in constant connection, in combination with two fixed electrodes, both of which are in connection with said contact arms when the switch is closed and both of which are cut out when said switch is opened.

467,509. Electric Drill System; Harry H. Marvin, of Syracuse, N. Y., Assignor to the Marvin Electric Drill Company, of same place. Application filed Aug. 15, 1891. The combination, with an alternating current generator and a reciprocating drill having two energizing coils, of a divided conductor from one generator terminal to the two coils, respectively, and a device in each branch of said conductor for producing a counter electromotive force or electrical resistance to currents of a given direction, but not to those in an opposite direction.

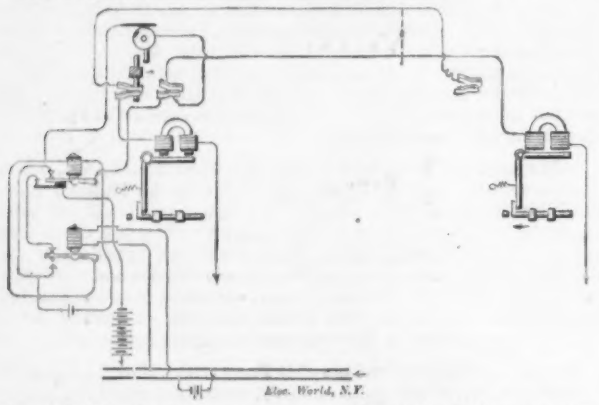
467,510. Electric Drill System; Harry N. Marvin, of Syracuse, N. Y., Assignor to the Marvin Electric Drill Company, of same place. Application filed Aug. 21, 1891. The combination, with a generator of rising and falling currents and a reciprocating drill or tool provided with two magnetizing coils, of a switch for directing the current alternately through the said coils, and a rotary synchronizing motor driven by the current and connected with and operating the said switch. (See illustration.)

467,511. Hanger for Electric Lamps; David B. Matson, of Buffalo, N. Y. Application filed Nov. 24, 1891. The combination, with a vertically moving lamp and permanently fixed line wires, of switch mechanism and separable pivoted contacts between the lamp and wires and between the adjacent ends of the wires for each lamp, whereby the circuit is made through one set of contacts before it is broken through the other without lowering the wires.

467,520. Composition of Matter for Insulating Purposes; David H. Piffard, of Piffard, N. Y. Application filed May 26, 1891. A composition of matter for insulating purposes, consisting of rubber rosin and plaster of paris, or its equivalent, in the proportions by weight of 5 rubber, 24 rosin, and 26 plaster of paris, more or less.

467,523. Incandescent Electric Lamp; Edward P. Roberts, of Cleveland, O., Assignor to the Swan Lamp Manufacturing Company, of same place. Application filed July 15, 1891. In an incandescent electric lamp, the combination with the bulb, socket-piece, and material in the socket-piece connecting it with the bulb of air passages extending through said connecting material from the butt of the bulb to the outlet of the socket piece.

467,537. Alternating-Current Motor; Ludwig Gutmann, of Pittsburgh, Pa. Application filed Nov. 29, 1889. An electric motor consisting of the combination of field magnets in circuit with an alternating current generator, an armature whose winding is divided into circuits unequal in virtual resistance, and a secondary current generator connected to said armature.



No. 467,581.—Electric Railway Signaling Apparatus.

467,538. Electric Heater; Ludwig Gutmann, of Pittsburgh, Pa. Application filed Nov. 12, 1890. In an electric heater, the combination of a box provided with a door normally closed and an electric conductor wound around and insulated from said box.

467,540. Electric Switch; Charles J. Klein, of New York, N. Y. Application filed April 6, 1891. In an electric switch, the combination, with a base of a wheel having eccentric arc-shaped surfaces, and a pair of tangential contact pieces arranged in the same plane opposite the arc-shaped surfaces and one outside of the other and so disposed that in the rotation of the wheel one contact piece will escape from an arc-shaped surface of the wheel, leaving the other bearing on the arc-shaped surface.

467,542. Carbon Brush Holder; Cyprien O. Mailloux, of New York, N. Y. Application filed March 18, 1891. The combination in a brush holding device of a holder-body, a conducting block or follower guided on said body and having cross arms or extensions resting directly upon and engaged with said follower so as to prevent tilting, adjustable springs attached at one end to said arms or extensions and at the lower end to the fixed body of the holder, and a brush or contact against which said block is held or forced by the pressure of said spring.

467,543. Apparatus for Charging Secondary Batteries; Cyprien O. Mailloux, of New York, N. Y. Application filed April 24, 1891. In an apparatus for charging storage batteries, a bank or battery of dynamos having different adjusted potentials and connected to separate mains or leads, in combination with switch devices for connecting a battery to be charged to any one of said mains or leads at pleasure.

467,544. Apparatus for Charging Secondary Batteries; Cyprien O. Mailloux, of New York, N. Y. Application filed April 24, 1891. In an apparatus for charging storage batteries, the combination, with one or more main charging dynamos, of charging leads or mains supplied thereby, and charging branches of said mains, each containing an armature of regulable capacity as an electromotive force generator.

467,545. Charging Secondary Batteries; Cyprien O. Mailloux, of New York, N. Y. Application filed April 24, 1891. The manner of automatically maintaining the strength of the charging current or rate of charge in a storage battery by running an electric motor with a constant torque by the charging current and allowing the automatic variation of counter electromotive force of said motor to compensate for the variations of electromotive force of the battery as the charge progresses.

467,546. Apparatus for Charging Secondary Batteries; Cyprien O. Mailloux, of New York, N. Y. Application filed April 24, 1891. In an apparatus for charging storage batteries, the combination of a main charging dynamo or source, a supplemental electromotive force generator acting either to assist the counter electromotive force of the battery of that of a charging source and a switch and connections whereby said supplemental generator may be thrown into or out of the charging circuit, including the main generator and the battery, according to the state of charge and counter electromotive force of the latter.

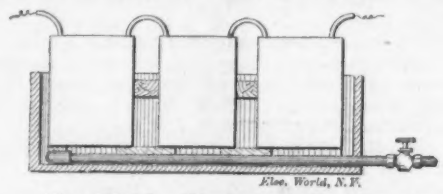
467,547. Apparatus for Charging Secondary Batteries; Cyprien O. Mailloux, of New York, N. Y. Application filed April 24, 1891. In an apparatus for charging storage batteries, the combination of two or more supplemental electromotive force generators connected in series with the main charging dynamo, and acting to assist either the charging or the counter electromotive force of the battery, and switch devices having connections to intermediate points of the series of machines, whereby a different number of supplemental machines may be included in series with the battery, according to the state of charge or counter electromotive force of the latter.

467,551. Automatic Electric Controller for Air Pumps; Adolph Bergmann, of New York, N. Y.; Bertha Bergmann, Administratrix of said Adolph Bergmann, deceased. Application filed Sept. 18, 1890. The combination of an air or gas pump, an air tank or receptacle the air space of which is connected directly with said pump and is supplied with air or gas under pressure thereby; a cask, barrel or other receptacle from which malt liquors are dispensed, connected with said tank; a pressure gauge, also connected with said tank; an electric motor and electromagnetic starting and stopping switch for the latter, and a circuit controller governed by the pressure gauge and connected to the magnet or magnets of the starting switch.

467,573. Secondary Battery; Justus B. Entz, of New York, and William A. Phillips, of Brooklyn, N. Y. Application filed Jan. 7, 1891. The invention consists in applying heat to the cells, preferably at the bottom, while they are being charged or discharged, thus setting up a circulation of the electrolyte. (See illustration.)

467,576. Incandescent Electric Lamp; Harry J. Gutman, of Des Moines, Ia. Application filed April 10, 1891. The invention consists in the combination with a globe, which is turnip-shaped in form and having a translucent upper shading or reflecting portion, of a circular filament extended in a horizontal plane concentrically within said globe at a point above the line of demarkation between the transparent and translucent portions thereof.

467,581. Electric Railway Signaling Apparatus; Frank I. Myers, of New York, N. Y. Application filed March 16, 1891. In a railway signaling system, the combination of a main locking-circuit, a local circuit controlled manually, a relay in said local circuit controlling the main locking circuit, a second local circuit controlling said relay, a second relay controlling said second local



No. 467,573.—Secondary Battery.

circuit, and a train operated circuit controller controlling the circuit of said second relay. (See illustration).

467,583. Trolley Wheel for Electric Cars; Levi A. Simons and George R. Roof, of Omaha, Neb. Application filed Jan. 22, 1891. The construction of a trolley wheel with cutting edged corrugations on the outer surface of the wheel.

467,610. Electric Arc Lamp; John A. Mosher, of Abilene, Kan., Assignor to the Mosher Arc Lamp Company, of same place. Application filed Jan. 24, 1891. An arc lamp comprising a derived circuit coil and its core, a carbon rod, a sleeve, a walking beam pivoted on the core, and a pendulous grip supported from said sleeve and actuated by the movement of the core.

467,611. Rheostat; John A. Mosher, of Abilene, Kan. Application filed April 4, 1891. A rheostat composed of heads, a cylinder held thereon, and strips surrounded by asbestos held to said heads and wrapped with braided wire.

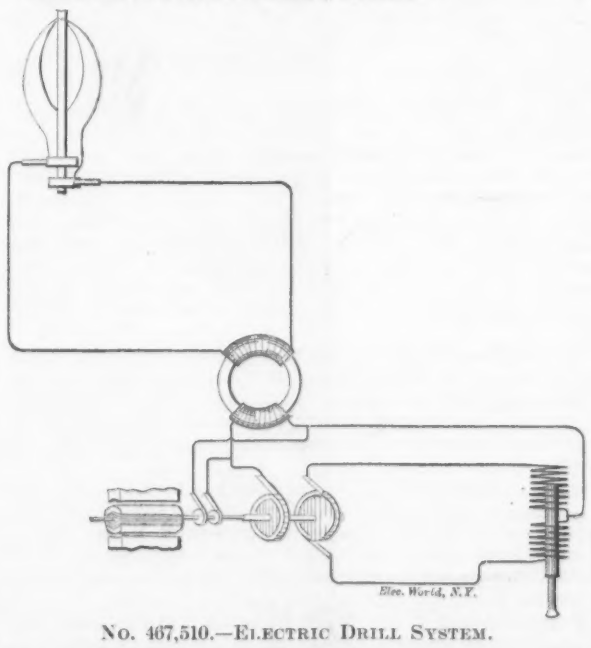
467,613. Contact Board for Rheostats; Sidney H. Short, of Cleveland, O. Application filed March 18, 1891. In a contact board for rheostats, the combination, with a board, of a series of contacts separated from each other by air spaces, each contact being constructed with a downwardly projecting foot at its opposite ends, whereby the body of the contact is elevated and separated from the board and air space is formed between them.

467,645. Magnetic Separator; Francis H. Richards, of Hartford, Conn., Assignor of two-thirds to Oscar S. Greenleaf, of Springfield, and Roswell M. Fairfield, of Holyoke, Mass. Application filed Oct. 12, 1891. In a magnetic separator for paper pulp the combination, with a trough having a depressed transverse magnetic floor section, of a pulp deflector depending into the trough over said section.

467,651. Electrical Signaling Apparatus; Patrick B. Delany, of South Orange, N. J. Application filed Sept. 19, 1890. The combination of an intermittently actuated lever, a time-indicating hand propelled thereby, a time dial over which the hand traverses, a circuit containing an alarm device and contacts that are closed when the lever is advanced to propel the hand one step, one or more contact plugs or pieces adapted to be placed at any desired point on the dial to form part of the alarm circuit, and a contact moving with the time-indicating hand to complete the alarm circuit through said contact piece or pieces.

467,656. Electric Arc Lamp; Charles E. Scribner, of Chicago, Ill., Assignor to the Western Electric Company, of same place. Application filed July 3, 1888. In an electric arc lamp containing two sets of carbons, the clutch levers supported a short distance above the lifting lever, and a cut-out carried by said lifting lever may be raised a short distance without being obstructed by the weight of the clutch levers.

467,669. Meter for Electric Translating Devices; Henry H. Cutler, of Newton, Mass. Application filed Jan. 2, 1889. An apparatus for indicating the time of operation of a number of instruments, machines, or electric translating devices, said apparatus comprising an electric circuit, and an ammeter responsive to variations in the quantity of the current in said circuit, and electric switches or circuit-changers at each of said instruments the time of operation of which is to be measured, each connected to be operated in unison with the starting and stopping device for the corresponding instrument, and means at each of said switches by which the amount of current passing through the said ammeter is varied when each of said switches is operated.



No. 467,510.—Electric Drill System.

467,678. Station Indicator; Reuben B. Ayres, of New York, N. Y. Application filed July 27, 1891. In an electric street or station indicator, the combination of a spirally grooved circuit-closing disc having a backing of conducting material and provided in said groove with a series of electrical contact points and a movable lever carrying a contact point which traverses said groove and successfully engages the points therein.

467,679. Electric Conductor Support; Eben Moody Boynton, of West Newbury, Mass. Application filed March 19, 1891. A bifurcated beam having in its interior blocks of insulating material, from which blocks one or more conductors are suspended.

467,684. Door Opener; Charles H. Grebenstein, of New York, N. Y. Application filed June 26, 1891. In a door opener, the combination of a lock keeper normally pressed forward into the locking position, mechanism for retracting said lock keeper against said pressure, a latch for retaining said lock keeper in its retracted position, and a cam surface arranged to trip said latch and release the lock keeper, to be again returned to the locking position by the aforesaid pressure.

467,699. Electric Railway; Warren B. Hutchinson, of Passaic, N. J. Application filed April 14, 1891. In an electric railway, a hollow carrier for the main conductor, said carrier having a longitudinal slot in one side and having its rear wall inclined downward to the slot.

467,716. Incandescent Lamp Socket; Patrick Dunn, of Cleveland, O. Application filed March 12, 1891. The combination, with the electrical circuit in an incandescent lamp, of a pivoted spring lever, spring plate, thumb lever and spring latch.

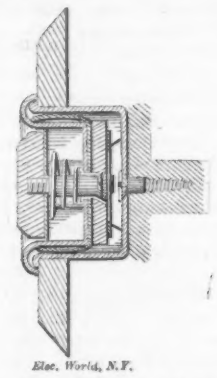
467,738. Adjustable Electrode for Dental Purposes; William P. Horton, Jr., of Cleveland, O., Assignor of one-half to Ansel B. Jones, of same place. Application filed June 10, 1891. In a metallic bow provided with a binding post, elbows pivotally secured upon the ends of said bow, and electrode discs adjustably secured in the ends of said elbows.

467,748. Electric Clock; Frank A. Ellis, of Toronto, Canada. Application filed June 13, 1891. In an electric clock a vertical bar suspended from an arm or lever, connected to an armature, a pawl, pivoted on the bar and designed to engage with a toothed wheel, a spring designed to act against the pawl, a pin extending from the bar and designed to come in contact with the toothed wheel when the bar has fallen, in combination with an electric circuit extending from a magnet to the escape wheel or other moving part of a clock by which the said circuit may be made and broken at stated intervals.

467,752. Arc Metal Working Apparatus; Henry Howard, of Halesowen, England. Application filed July 6, 1891. An apparatus for heating or welding by the electric arc, in which the work forms one electrode, comprising a pencil forming the other electrode mounted to move longitudinally and transversely and mechanism for effecting these movements.

467,773. Regulation of Electric Circuits; Frank B. Rae, of Detroit, Mich., Assignor to the Detroit Electrical Works, of same place. Application filed May 1, 1889. The combination, with the source of electric energy of an electric motor, the field magnet of which is provided with a plurality of field magnet coils, of a circuit-controlling switch consisting of a cylinder provided with a duplicate set of insulated contact plates arranged, a series of brushes arranged to bear on the contact plates, connections between the contact plates and the terminals of the field magnet coils, connections between the armature coil and current reversing plates on the switch and a rheostat and connections between the same and plates on the switch, whereby the current of the motor can be controlled.

467,774. Electric Tell-Tale for Tanks; Charles Reuter and George Bollmann, of Brooklyn, N. Y. Application filed June 19, 1891. An electric tell-tale for tanks, consisting of an upright standard supported in said tanks, guide brackets insulated from said tanks, a float, the stem of which is guided by said brackets, a contact bracket attached to said standard above the stem, and electric connections between the stem of the float and the contact bracket, so that the height of the water level in the tanks is indicated in a suitable manner.



No. 467,875.—Push Button.

467,833. Magnetic Separator; Francis H. Richards, of Hartford, Conn., Assignor of two-thirds to Roswell M. Fairfield, of Holyoke, and Oscar S. Greenleaf, of Springfield, Mass. Application filed Sept. 29, 1891. In a magnetic separator, the combination with a framework and with a magnet having alternating strong and weak fields or zones, there being a pulp passageway between the framework and magnet of one or more sets of deflectors located adjacent to the magnet in said passageway, and acting to laterally deflect the current therein, whereby the fluid acted upon is directed from the weak toward the stronger field or zone.

467,875. Push Button; Adam Lungen, of New York, N. Y., Assignor to himself and Robert Edwards, of same place. Application filed March 4, 1891. The combination of a contact making mechanism for push buttons, face plate, and means for securing the said plate in place, which consists of a cup-shaped member provided with flanges which bear against the front of the face plate, and a fastening screw for the latter. (See illustration.)

467,884. Station Indicator; Reuben B. Ayres, of New York, N. Y., Assignor to Aaron L. Ayres, of same place. Application filed Feb. 16, 1891. In an electrical street or station indicator the combination, with a metallic case or housing having openings in its front, of a pair of revolving drums, an indicating sheet or ribbon operated by said drums and formed throughout with a series of perforations or openings, a spring-supported contact adapted to project through the openings of the ribbon to form an electrical circuit with the case, clutches for engaging the drums, a shifting lever for operating the clutches, a locking device for said lever, an electromagnet and its armature, and a suitable battery and wire connections.

467,891. Electric Wire Tapper; Gustave S. Neu, of New York, N. Y. Application filed Sept. 17, 1891. An electric wire tapper comprising a V-shaped seat for the wire, a guide, and a sharp pointed contact to pierce the insulation guided in a line directed at the centre of the V-seat.

467,897. System of Electric Distribution; Nelson W. Perry, of Cincinnati, O. Application filed April 13, 1891. The combination, in a system of electric distribution for movable translating devices, of a sectional current-conveyer, switches normally closing the gaps between the sections, two lines of working conductors arranged in pairs, each conductor lapping the succeeding conductor of the same line, but normally insulated therefrom, a connection between one member of each pair of working conductors and one section of the main conveyer, a connection between the other member of the pair through the switch-controlling magnet and another section of the main conveyer, switches adapted to break these connections, magnets controlling the switches, supplemental conductors adjacent to but normally insulated from the lapping portions of one line of conductors, and a connection from the supplemental conductors through the magnet controlling one of the switches in the main circuit to the magnet controlling the switch in an adjacent section, and thence around the switch to the main circuit.

467,901. Test-Circuit for Multiple Switchboards; Charles E. Scribner, of Chicago, Ill. Application filed May 29, 1891. The combination, in a circuit open at two points, of contacts whereby the circuit may be closed at either point or at both of two sources of intermittent currents, one source giving currents of opposite direction to and complementary to those from the other source, and a polarized device adapted to respond to composite currents from the two sources.

467,902. Test-Circuit for Multiple Switchboards; Charles E. Scribner, of Chicago, Ill. Application filed May 29, 1891. In a test-circuit for multiple switchboards, the combination of several electrically connected test rings of spring jacks, with a branch connection from one of the test rings to earth, including a source of intermittent or pulsatory electromotive force, a second branch connection from another of the test rings to earth, including a telephone and a vibrating circuit breaker in shunt thereof, and a second source of intermittent electromotive force whose pulsations are complementary to and in the same direction in the test circuits as those from the first source.

Copies of the specifications and drawings complete of any patent mentioned in this record—or of any other patent issued since 1886—can be had for 25 cents. Give date and number of patent desired and address The W. J. Johnston Co., Ltd., Times Building, N. Y.

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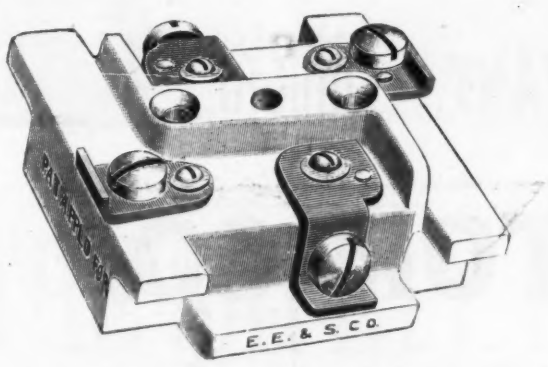

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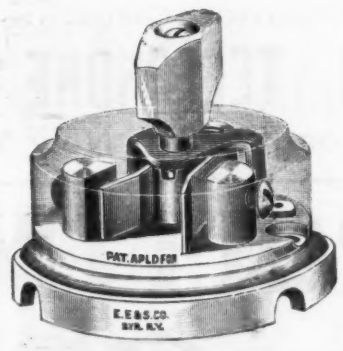

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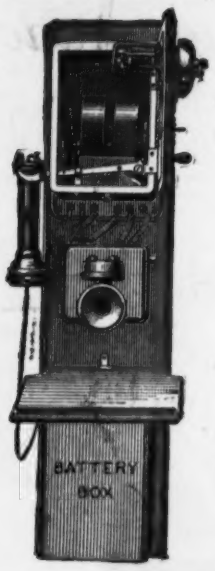

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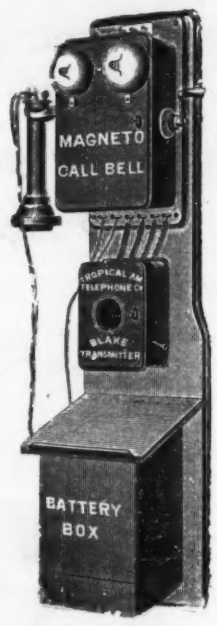

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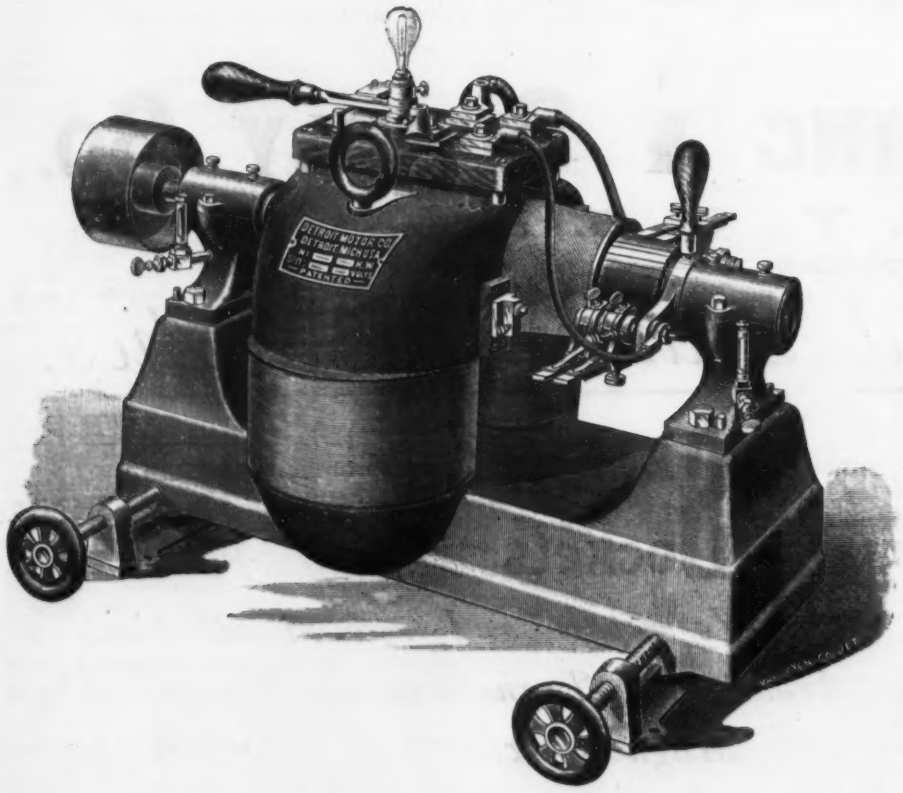

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Armature of very low resistance and the fewest turns without bringing speed too high; symmetrical winding, diametrically opposite sections being of exactly the same length; the winding of the armature sections in parallel turns, thus reducing to a minimum the heat waste and local action that occur in a large inductor; the high resistance of the field circuit, the current expended in the field being 1½ per cent. in some sizes; the great intensity of the field with comparatively low weight of copper, admitting of an armature of small diameter running at the ordinary speed; the large cross-section of the magnet cores and pole-pieces, making a magnetic circuit of very low resistance; the use of very soft forged iron field pieces instead of cast iron; the division of the armature into the greatest number of sections, thus eliminating the injurious results from the short circuiting of one section by the brushes; the base neutral and not one pole of machine; the absolute absence of heating, sparking or lead to brushes at full load; the high grade of insulation used in the armature and field coils.

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Low centre of gravity; breadth of base; freedom from vibration; extra large size of shaft of fine steel; perfect balance of armature; self-oiling bearings; bronze boxes of superior design; journals supported in universal ball joint; self-centring pillow-blocks; oil gauge cocks showing amount of oil; no end thrust from shaft; brush-holders admitting of a wide range of adjustment with the greatest convenience; easily accessible large strong binding posts; switchboard on top of machine; long wearing commutator of extra large size; smooth finish of all iron parts and high finish of all brass work; ease with which all parts may be assembled or separated.

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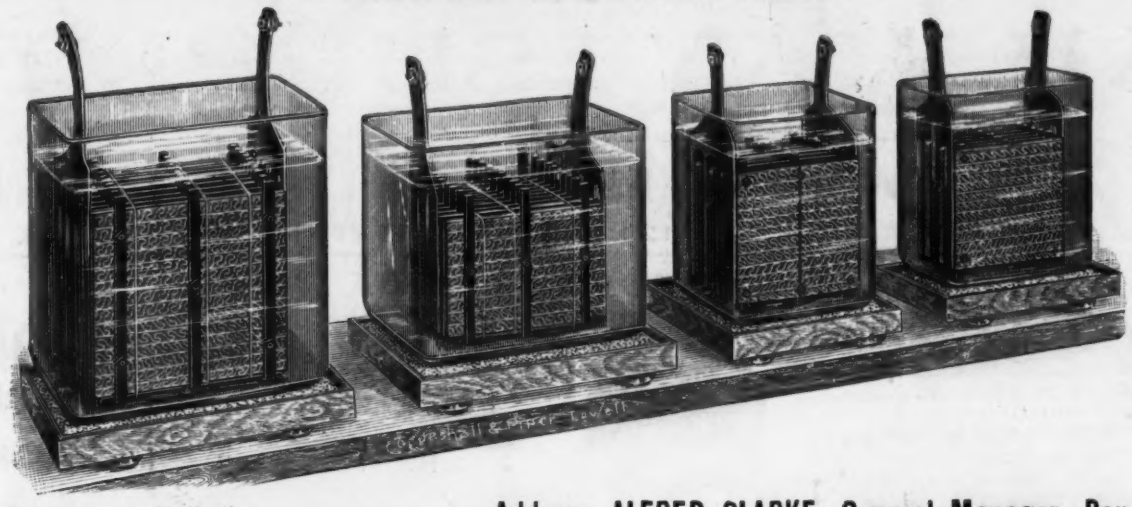

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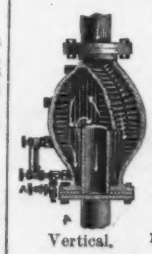

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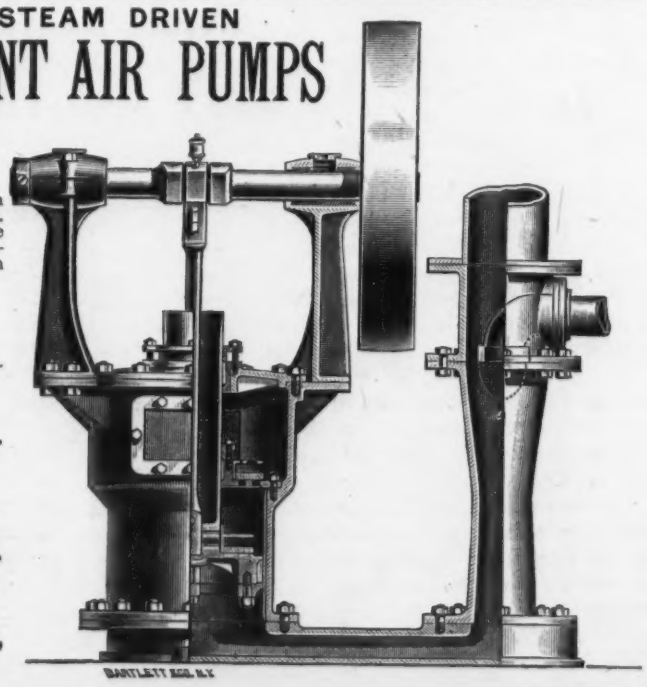
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